Importance of Financing for Nepalese Agriculture and Economic Development

by

Sandip Nepal

Thesis
Submitted to the Department of Geography
in Partial Fulfillment of the Requirements for the Degree of
Master of Philosophy in System Dynamics

System Dynamics Group
Department of Geography
University of Bergen

May, 2015

Acknowledgements

My sincere gratitude goes to the University of Bergen for providing me with the wonderful opportunity to pursue the degree of Master of Philosophy in System Dynamics and this thesis as a part of the study. I am indebted to Professor Erling Moxnes, System Dynamics Group, for his continuous guidance, encouragement and contribution throughout the process of writing this thesis. The thesis wouldn't have been possible without his immeasurable support. In addition, I would like to thank my friends and colleagues for their immense support and motivation. I sincerely appreciate the support and encouragement provided by Ms. Jacynta Spicer and Ms. Johanna Gisladottir, which proved to be vital in the completion of this thesis work. Furthermore, I am really grateful to all the individuals who facilitated me with data and information, without which the execution of the thesis would be challenging.

Mr. Iswar Nepal (Secretary, Government of Nepal) and Mr. Chittaranjan Pandey (King's College, Kathmandu, Nepal) provided tremendous support on data collection.

Lastly, I feel that I wouldn't be able to finish this thesis, if it wasn't for the blessings of my parents and the eternal love of my beloved spouse.

Thank you very much Sarita Nepal, Dilip Nepal and Akina Singh Dangol, for always being by my side.

This Thesis is dedicated to all the Nepalese who lost their lives in the Nepal earthquake of April 25, 2015 and the following aftershocks.

Abstract

The agriculture sector in Nepal has not been growing as expected over the last decade. To understand the ongoing dynamics in the Nepalese agriculture sector, the study states a hypothesis that lack of effective and efficient financing cause slow agriculture sector growth. The hypothesis is tested using a system dynamics model representing the Nepalese agriculture sector with causalities of financing on the sector. The analysis of the hypothesis states that insufficiency in formal banking access causes aggregate interest rate to rise, which reduces investment and capital in the sector, causing production levels to fall and vice versa. The model used to test the hypothesis replicates the historic production trajectory in the Nepalese agriculture sector with only a maximum deviation of an approximate 5 percent. Based on the reliability of the model in terms of representing the Nepalese agriculture sector for the past 15 years, two policies are proposed to increase productivity. The policy propositions, expansion of formal banking market share and interest rate cut, to cost-effectively cover the rural agriculture sector, result in significant improvements on production and income levels over the next 25 years. These policies have significant positive implications for restructuring the growth trajectory of the Nepalese agriculture sector towards an optimistic outlook.

(*Note: Due to time constraint, the study doesn't incorporate the consequences of the Nepal earthquake of April 25, 2015*)

Table of Contents

1. Introduction

The agricultural sector in Nepal is not developing as hoped for with several likely negative consequences for the sector itself and for the rest of the economy. The hypothesis explored in this thesis is that lack of efficient financing mechanism is a major reason for the problems. To test the hypothesis a system dynamics model is developed. The hypothesis is not rejected and for that reason, the thesis ends with a discussion of policies to increase the availability of financing for the agricultural sector.

Average growth rate in output of the agricultural sector in Nepal for the last decade is only 3.2 percent. The growth rates in the agriculture sector for last ten years range from 1 to 5.8 percent with extreme volatility in the growth rate year after year. This unsustainable growth rates suggest that the agriculture sector in Nepal is lacking priority. The slow productivity growth towards a potential in the agro sector that could be considerably higher has implications for the entire economy. According to a macroeconomic report published by the central bank of Nepal based on the annual data of 2013/14 AD, increase in the price index of fruits and vegetables were 20.5 percent and 13.7 percent respectively during the review period of 12 months. This is relatively high compared to the general inflation of 9.1 percent during the same period. The meager growth rate in the agriculture sector with such a significant contribution to Gross Domestic Product (GDP) affects overall economic growth rate in Nepal.

In this thesis, we state a hypothesis that lack of effective and efficient financing mechanisms causes slow agriculture growth and increased food prices. We also hypothesize that the agriculture sector strongly influences economic growth rate in Nepal. As the agriculture sector in Nepal lacks sufficient government focus, food prices in Nepal increases significantly based on local production and supply issues. Inefficiency in agro financing has not only hindered farmers economically, but has also risen general food prices due to increasing imports to fulfill local demand of agro products. Absence of a comprehensive financing mechanisms results in high capital and interest costs for the agricultural sector, eventually affecting income generating capacity and living standards of farmers. High interest rates imply that the farmers are not able to accumulate much wealth. This prevents a virtuous circle where the surplus from one year enables investments and increased investments the next year. This cycle, in the long run, discourages farmers and can possibly displace many from the agriculture sector.

At a more detailed level, the hypothesis states that the agro sector in Nepal lacks coordinated financing. Lack of effective financing mechanism prevents farmers to avail credit facilities with nominal interest rates from formal banking system. This in turn, makes loanable funds very expensive to the farmers combined with higher interest rates charged by informal lending in rural sector where there are no formal lending authorities. As the aggregate lending rates are extremely high, the efficiency and productivity of the agro sector goes down with reduced investment capacity. Consequently, the growth rate in the agriculture sector is not realized as hoped. With unsustainability in Nepalese agriculture sector due to lack of effective financing support and extremely high interest rates, traders are forced to import agro products to fulfill the local demand. This further causes food prices to rise and triggers inflation that affects farmers’ real income, real GDP and eventually economic growth rate.

Finally, analysis of the model used in this thesis suggests that increase in access of formal banking in rural areas offering nominal interest rate facilitates a rapid agro sector growth. Furthermore, with lowered cost of production in the agro sector, food prices in general are also lowered with reduced imports of agro products helping Nepal to become self-reliant on agro products. In general, the policy intervention incorporating expansion of urban banking targeting the agro economy shows a significant growth in the agro sector, control in food prices and a tremendous contribution of the agro sector to GDP.

This thesis is mainly divided into four sections starting with the review of various related literatures. The third section of the study focuses on a hypothesis. The hypothesis is tested using a system dynamics model representing the Nepalese agriculture sector and analysis of the hypothesis tests how financing slows growth in the Nepalese agriculture sector. The thesis continues with a discussion on policy and implementation structures for proposed policy interventions. This is followed by a conclusion and recommendation section focused on reforming the financial system in Nepal.

2. Literature Review

The thesis is primarily based on a hypothesis that lack of effective and efficient financing mechanism causes slow agriculture sector growth. As the agriculture sector in Nepal lacks a structured agro financing regime to facilitate entire stakeholders involved in the sector, the sector is not growing as hoped for over the last decade. Furthermore, the agriculture sector, which contributed 33.1 percent to GDP at current prices in fiscal year 2013/14 (Economic Survey 2014), significantly influences economic growth rate in Nepal. With the agriculture sector lacking sufficient growth, the country's economic growth rate is also affected.

Different studies have shown interesting findings concerning agriculture sector in the past. According to Hatlebakk (2009), high rural interest rates seem to be a major obstacle to rural agriculture development in Nepal. He further emphasize that some poor farmers are in a vicious circle, where they every year take the same consumption loan, which is, on average, repaid with 50% real interest rate. In his study, Hatlebakk focuses on price determination in informal rural credit markets in Nepal. He further emphasizes on interest rate determination mechanism in rural credit markets, which is purely based on social background of borrowers and loan tenures. Furthermore, his study suggests that the price discrimination in rural credit market is a major problem in the agriculture sector. The findings from Hatlebakk's study in Nepalese rural agro sector clearly suggest that farmers in the rural agriculture sector in Nepal are exploited by informal lending sector, which consists of individual lenders with substantial capital ownership. Unlike in Hatlebakk's research, which focuses on interest rate determination and discrimination in Nepal's rural agro sector, this thesis focuses on lack of formal financing structure in aggregate agriculture sector in Nepal and aims to see its impact on the agriculture sector growth and food prices. As an important component of financing mechanism, however, the study focuses on the aggregate interest rate being charged in the agriculture sector in Nepal. By focusing on inefficiency in interest rate structure in formal lending sector, the study also attempts to eradicate the informal credit in Nepalese agriculture sector by strengthening the formal credit structure. Furthermore, this thesis also endeavors to identify causality within interest rate, productivity in the agro sector and income level as a cyclical process.

Tiffin and Irz (2005) in their study "Is agriculture the engine of growth" focus on causality between agricultural value added per worker and GDP per capita, where they conclude that agricultural value added is a causal variable in developing countries. Their study confirms that agriculture is the engine of growth in developing countries. Furthermore, the study also verifies that agricultural productivity growth is necessary to get the economy moving as it releases surplus of food, labor, raw materials, capital and foreign exchange, while simultaneously generating demand for industrial goods and services. Similar to the analysis of Tiffin and Irz, this thesis also attempts to understand the impact of financing mechanism on the agricultural sector growth in Nepal. However, this thesis strictly focuses on the role of effective financing structure in formal sector on effectiveness in the agricultural sector. Here, effective financing structure refers to ease in availability of loanable funds or capital and justifiable interest rates in formal lending system. Because, if funds are not easily available at reasonable interest rates, it affects growth in the agriculture sector, which in turn increases food prices, creates unemployment problems, eventually affecting aggregate economic growth rate in the long run.

Irz, Lin, Thirtle and Wiggins (2001) in their study "Agricultural Productivity Growth and Poverty Alleviation" emphasize on the role of agricultural growth in poverty alleviation. Amidst agricultural growth, they present arguments for job creation, linkages from farming to rest of rural economy, and a decline in real cost of food for whole economy. The study strongly exhibit consequences of agricultural growth in terms of higher incomes for farmers, increased employment and rise in farm wage rates, improved investment and welfare, and more tax revenue. Furthermore, with agricultural sector gaining momentum, demand for better infrastructure (roads, power supplies, communications) is generated. Consequently, the national economy is better-off in terms of reduced food prices, increased real wages, rise in saving, improved foreign exchange allowing import of capital goods and essential inputs for agriculture sector. Furthermore, as the agriculture sector drives entire economy in developing countries, other forms of industries are also better-off with the agriculture sector performing well. Irz et al. (2001) in their research postulate that a yield increase of one-third in agriculture sector might reduce the numbers in poverty by a quarter or more. Despite Irz et al. (2001) in their study emphasize on impact of agricultural growth in poverty alleviation, they have not focused on how to achieve growth in the agriculture sector. Now, from their research, it is evident that agricultural growth is an engine for poverty alleviation, our concern in this thesis is to achieve growth in the agriculture sector to improve living standard of the people in Nepal. Nepal lacks sufficient focus on financing mechanisms for the agriculture sector. Due to lack of formal lending authorities at a nationwide level, the agriculture sector in Nepal is facing capital rationing issues. Furthermore, as the government of Nepal has not been able to implement nominal interest rate structure for the entire agriculture sector, farmers are forced to take loans at higher interest rates from both formal and informal sectors. This results in reduced investment, yield, income, saving in the agriculture sector which compromises the living standard of people as a whole. Thus, the study focuses on strengthening financing regime in Nepalese agriculture sector with strict focus on establishing formal lending institutions at a countrywide level offering nominal interest rates.

3. Analysis of Hypothesis

In this chapter, the model used in the study is tested and explained. The model is partially presented and detailed with separate sections for each components of the model. While presenting the model, one of the most important sections, capital sector as indicated by Capital Mobilized, is considered at first and then the rest of the model is presented following the loops or sequence in the model.

3.1. Capital Mobilized

In the model, ‘Capital Mobilized’ (CM) is a stock of the accumulated capital over time in the agriculture sector in Nepal. CM represents the total physical capital deployed in the agriculture sector and involved in production activities. Physical capital includes machineries, tools and equipment, fertilizers, pesticides, all kind of vehicles involved in the sector and warehouses. The development of CM is the result of ‘Investment’ (I) and ‘Depreciation’ (D). Here, I is the yearly investment made in the agriculture sector to acquire capital required for agricultural activities and D represents yearly devaluation of CM.

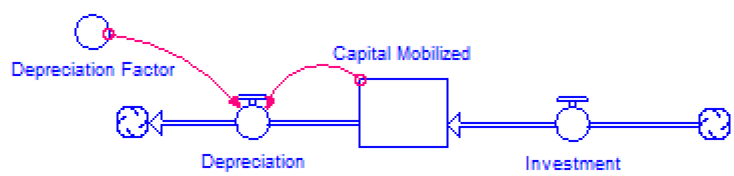

Figure 3.1. SFD for CM with its respective flows

(Note: Refer to Appendices section for the complete model)

Equation 3.1.1 shows the computation of CM in the model and equation 3.1.2 is an expression for the initial value of CM in the base year, which stands to be NPR 200 billion.

Capital Mobilized (t) = Capital Mobilized (t - dt) + (Investment - Depreciation) * dt

(Equation 3.1.1)

INIT Capital Mobilized = 200,000,000,000 ***(Equation 3.1.2)***

In the equations above, ‘t’ represents time and ‘dt’ represents change in time.

Here, CM is the function of CM over time in addition to the difference of I and D with respect to time. In the model, CM in the base year is estimated to be NPR 200 billion. In the absence of data on actual capital mobilized in the Nepalese agro sector, CM is calibrated in the model. CM is considered as a causal variable of production. Thus, the initial value of CM is based on the production function in the model.

In figure 3.2, the simulation behavior of CM over the time period of 15 years is displayed. CM, which starts at NPR 200 billion in the base year, grows to NPR 393 billion by the end of 2014 with a steady-state growth.

In the simulation period of 15 years, CM increases by approximately 96.5 percent. With gradually increasing investment, the inflow of CM, the total capital deployed in the agriculture sector in Nepal shows a steady growth. Furthermore, despite yearly depreciation rate of 10 percent, CM increases over time in accordance with the increasing level of investment from banks and retained earnings of the farmers.

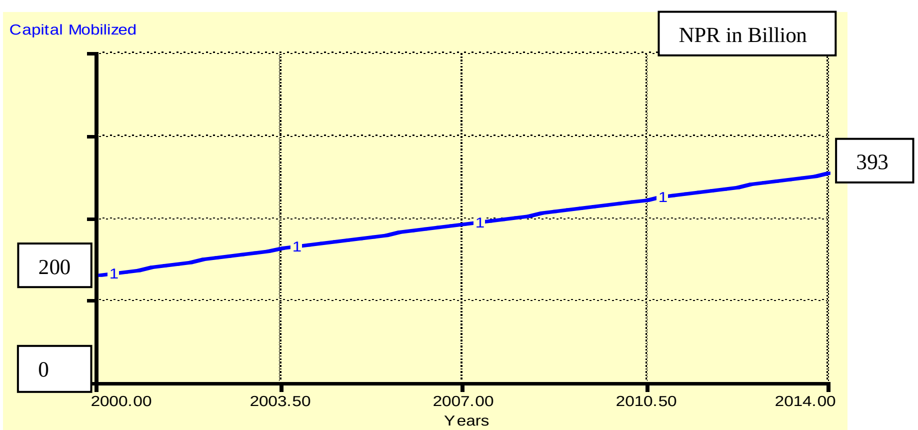

Figure 3.2. Simulation Behavior of CM

3.1.1. Depreciation

In economic terms, depreciation means decrease in value of assets. Thus, the equation presented in the model calculates yearly usage of CM in accordance with Depreciation Factor (DF). Here, DF is an average of depreciation rates, considered as an index of depreciation in the agriculture sector, used in Nepal in accounting purposes for various kinds of machines, tools, equipment and vehicles. Thus, considering the accounting practices in Nepal, an average depreciation rate of 10 percent is considered in the model to compute yearly depreciation of CM.

Equations 3.1.3 and 3.1.4 represent the computation of D and DF respectively in the model.

Depreciation = Capital Mobilized*Depreciation Factor **(*Equation 3.1.3*)**

Depreciation Factor = 0.1 **(*Equation 3.1.4*)**

3.1.2 Investment

Investment refers to the sum of total financial contribution of the Nepalese banking sector and farmers in the agriculture sector in Nepal. Actual Borrowing Rate (ABR) is the total amount of financing received from the banking sector and Retained Earnings (RE) is net saving of the farmers in the Nepalese agriculture sector accounted after financial and household obligations. Both ABR and RE are explained in the following section of this chapter.

Investment, purely determined by ABR and RE exhibits a tremendous growth during the simulation period. Investment which starts at approximately NPR 35 billion in the base year stands at approximately NPR 54 billion at the end of the simulation period, which is 2014. This shows that investment in the Nepalese agriculture sector grew by over 50 percent over the period of 15 years. Thus, increase in investment from banks and farmers' retention of income increases investment in the Nepalese agriculture sector.

The equation for 'I' as used in the model:

Investment = Actual Borrowing Rate + Retained Earnings **(*Equation 3.1.5*)**

3.2. Production

In the model, production (P) refers to the total output of agricultural products produced in the Nepalese agriculture sector. The level of CM combined with the contribution of households determines production. Production is calculated using the 'Cobb-Douglas' production function. The 'Cobb-Douglas' production function calculates output based on the availability of factor inputs, which are CM and Households (H) in the model. The equation gives the amount of output that can be produced using these factor inputs. Here, we also use output elasticity of CM and H as represented by Capital Exponent (CE) and Household Exponent (HE) respectively in the model.

In the following equation, which is used in the model to calculate P, the amount of production in the base year is multiplied with relative values of H and CM with their respective exponents or elasticity factors.

Production =
Base_Year_Production*((Households/Households_in_Base_Year)^Household_Exponent)*((Capital_Mobilized/Base_Year_Capital)^Capital_Exponent) ***(Equation 3.2.1)***

In the proceeding section, the components of P are explained in detail.

3.2.1. Base Year Production (BYP)

It represents the volume of output produced in the base year in the Nepalese agriculture sector which stands to be 1.5 billion kilograms of output. This figure is taken from a recent publication of the Government of Nepal, Finance Ministry (Economic Survey, 2014).

The equation for BYP as used in the model;

Base Year Production = 1,500,000,000 ***(Equation 3.2.2)***

3.2.2. Households

H, as used in the model, is the number of economic units of agricultural production contributing in the production process by availing single or multiple workforces. The data for H is considered from a report published by the Central Bureau of Statistics, Government of Nepal (National Sample Census of Agriculture, 2013). An average growth rate for the period of 14 years is computed and the growth rate is applied to the number of households in the base year, i.e., 2000. Equation 3.2.3 generates a development of H over time, which replicates the data published by the Central Bureau of Statistics. Equation 3.2.3 is used to estimate the number of H even after 2014, for policy analysis.

Households_in_Base_Year*EXP(0.0140*(time-2000)) ***(Equation 3.2.3)***

3.2.3. Households in Base Year (HBY)

HBY is the number of households actively involved in the production process in the Nepalese agriculture sector in the base year. The number of H in the base year is 3.4 million households. For further details, refer to section 3.2.2.

The equation for HBY as used in the model is;

Households in Base Year = 3,400,000 ***(Equation 3.2.4)***

3.2.4. Household Exponent

HE is an output elasticity that measures the responsiveness of output, i.e., P in the model, to a change in the level of H used in production. The weight given to HE as an output elasticity factor of H is .45, i.e., 45 percent. The elasticity assigned is a proxy of the contribution and significance of H in the Nepalese agriculture sector.

The equation for HE as used in the model:

Household Exponent = 0.45 ***(Equation 3.2.5)***

3.2.5. Capital Mobilized

Refer to section 3.1.

3.2.6. Base Year Capital (BYC)

It is the value of total capital available in the Nepalese agriculture sector in the base year. For simplicity, BYC is the initial value or base year value of CM in the model which stands to be NPR 200 billion. For further details, refer to section 3.1.

The equation for BYC is given as;

Base Year Capital = 200,000,000,000 ***(Equation 3.2.6)***

3.2.7 Capital Exponent

CE is also an output elasticity that measures the responsiveness of output, i.e., P in the model, to a change in the level of CM used in production. The weight assigned to CE in the model is .55, i.e., 55 percent. The weight is assigned based on an approximate estimate of the contribution of the capital sector, CM in the model, in the Nepalese agriculture sector. This implies that the capital sector dominates the agriculture production over household sector in Nepal.

The equation for CE is given as;

Capital Exponent = 0.55 ***(Equation 3.2.7)***

3.2.8. Comparison of the Model Behavior and the Reference Mode

In figure 3.3, the behavior of P given by the model is ‘Production’, represented by trajectory 2, and the reference mode is ‘Production Data’ as represented by trajectory 1. The actual data for production is taken from a recently published economic survey conducted by the Government of Nepal (Economic Survey, 2014). Both the reference mode and the model simulation have production levels of 1.5 billion kilograms each in the base year. With a maximum volatility of about approximately 5 percent from the reference behavior, the behavior generated by the model corresponds with the reference behavior throughout the simulation period of 15 years. The production level by the end of 2014 according to the model simulation is 2.3778 billion kilograms which is extremely close to 2.38 billion kilograms, the reference point. The level of accuracy given by the simulation behavior corresponding to the reference mode clearly exhibits the robustness of the model in explaining the reference behavior in the Nepalese agriculture sector.

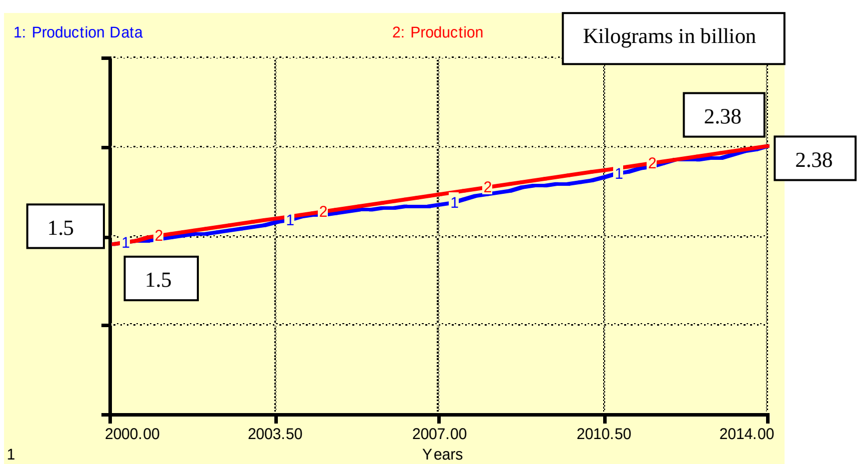

Figure 3.3. Reference mode versus Simulation Behavior of P

3.2.9. Sensitivity of Capital Mobilized on Production

In the model, I is the inflow to CM. The amount of CM over time changes with a change in the value of I. Sensitivity in I by 20 percent generates interesting production behavior over time as exhibited in figure 3.4. In the graph, the behavior of P as marked by '1' is given by the reference CM. Similarly, the production behavior marked as '2' and '3' are given by an increase and decrease in I by 20 percent respectively.

A 20 percent increase in I which results in increased CM increases production compared to the neutral production level. A 20 percent increase in I increases P by approximately 11 billion kilograms by the end of 2014. This exhibits that an increase in I increases P.

The sensitivity of P with a decrease in I by 20 percent is quite considerable. When I decreases by 20 percent, the development of P over time is considerably lower than the base or reference scenario. As given by the simulation, a 20 percent fall in I results in an approximate 10 percent decrease in P by the end of the simulation period, i.e., 2014. The production level in 2014 after reducing I by 20 percent over time stand at 2.13 billion kilograms.

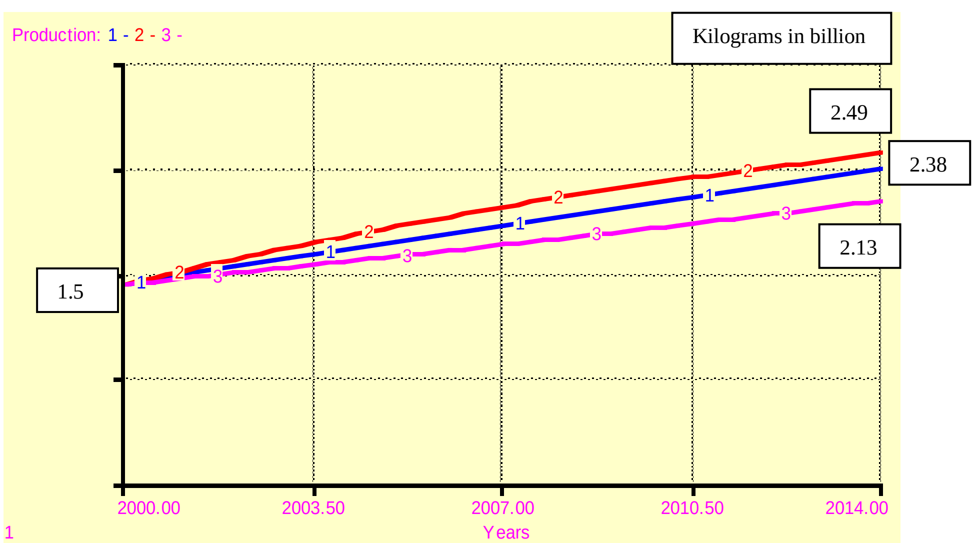

Figure 3.4. Sensitivity of CM on P by changing I

3.2.10. Sensitivity of Capital Exponent and Household Exponent on Production

Here, CE and HE are output elasticity factors which measure the responsiveness of P to a change in the level of inputs, CM and H in the model.

In the base year, as given by 'Production 1' in the graph below, CE and HE are .55 and .45 respectively which gives a production level of 2.38 billion kilograms in 2014. Testing the sensitivities of CE and LE, a CE of .60 and a HE of .40 gives a production level of 2.50 billion kilograms as represented by 'Production 2' in figure 3.5. Further, when CE is reduced to .50 from the base weight of .55, with HE of .50, the production level as given by 'Production 3' in figure 3.5, decreases to 2.25 billion kilograms.

These production levels with different output elasticity factors clearly exhibits that the production in the Nepalese agriculture sector is purely dominated by the capital sector. This explains the need of capital investment in the agriculture sector in Nepal.

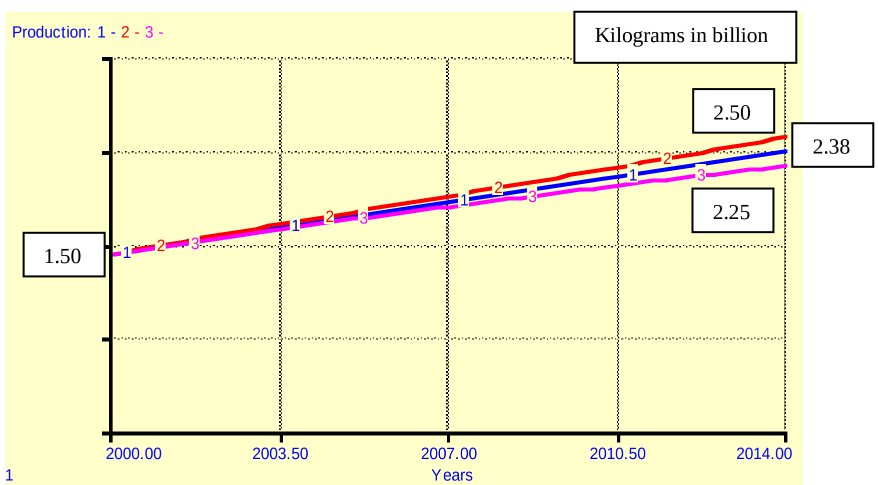

Figure 3.5. Sensitivity of CE and HE on P

3.3 Price (Po)

In the model, Po is derived by the interaction of demand and supply of agricultural products in the Nepalese economy. In a free market economy like Nepal, P is determined by the equilibrium point of supply and demand. Supply is given by the volume of production and demand is assumed to be constant with the supply in the study. Since, the study doesn't incorporate import of the agriculture products, demand is assumed to be equal to supply which is determined by the volume of production.

Po in the model excludes the effects of market inefficiencies and inflation. Market inefficiencies refer to involvement of market intermediary, brokers and transport business owners which increase final prices. The presence of market inefficiency makes products expensive for consumers and makes product market less attractive. Furthermore, as the effect of inflation is excluded from the model, Po derived by the model is real prices over the simulation period.

Equation 3.3.1 is derived using a demand function, thus, it is an inverse price function. Inverse price function is based on a base price, relative demand and price elasticity. As mentioned earlier, demand equals supply and supply is equivalent to P in the model.

The equation for Po as used in the model;

Price = (Base_Year_Price*(Production/Basic_Demand)^(-1/Price_Elasticity))

(Equation 3.3.1)

3.3.1. Base Year Price (BYPo)

BYPo represents a price index for agricultural products in the base year. Generally, the significance of BYPo is to identify the real growth in production. When total monetary value of production is computed using BYPo, development in production over time is observed. This is not the case with nominal price as it comprises the effects of inflation or yearly price rise. In the model, BYPo is considered from a recently published economic survey in Nepal (Economic Survey, 2014). The price in the base year according to the report is NPR 100.

The equation for BYPo in the model is;

Base Year Price = 100 ***(Equation 3.3.2)***

3.3.2. Production

Refer to section 3.2.

3.3.3. Basic Demand (BD)

In the model, as mentioned earlier, demand equals supply. The demand for 1.75 billion kilograms of agricultural products in the Nepalese agriculture sector in the base year is derived from the production level. The production level in the base year, which equals to supply, is 1.5 billion kilograms. Equation 3.3.3 uses relative figure of households to compute yearly BD. This implies that, BD changes proportionately with a change in number of households in the Nepalese agriculture sector. Except for BD, the model assumes that demand equals supply, which is derived from the production level.

The equations for BD and Base Year Demand as used in the model;

Basic_Demand = Base Year Demand *Households/Households_in_Base_Year

(Equation 3.3.3)

Where, ***Base Year Demand = 1750000000*** ***(Equation 3.3.3a)***

3.3.4. Price Elasticity (PE)

PE used in the model is the price elasticity of demand. It represents the responsiveness of demand of agricultural products in the Nepalese market to a change in price level. In the model, a PE of .95 is used. This implies that a change in price in agricultural products in Nepal has relatively small effect on demand. The Nepalese agricultural product market basically comprises of essential food crops. Thus, any change in price actually doesn't affect demand for such basic consumption products which includes rice, maize, lentils, potato, tomato, milk and alike.

Following is the equation for PE as used in the model:

Price Elasticity = 0.95 ***(Equation 3.3.4)***

(Note: Demand with a PE of less than 1 is inelastic and more than 1 is elastic)

3.3.5. Sensitivity of Price with Respect to Price Elasticity

Elasticity of price changes quantity demand in response to a change in price. In the model, as Po is derived using an inverse demand function, the impact of PE on demand changes the price level. Hence, the causality of PE is tested on Po.

The model runs with an assumption of a PE of .95 in the Nepalese agricultural product markets. ‘Price 1’ in figure 3.6 reflects the base run with a PE of .95. It gives a price level of NPR 89 per kilo by the end of the simulation period which starts at NPR 118 per kilo in the base year. This is an approximate change of **25 percent** in the price level. When PE is decreased to .50, which implies an inelastic demand, a price level of NPR 84 per kilo is achieved in 2014 with a higher price level of NPR 136 in the base year. This is a change of an approximate **38 percent** in the price level during the review period. Finally, a price level of NPR 92 per kilo is given by a PE of 1.50, representing an elastic demand condition, given by ‘Price 3’ in the figure below. The base year price level for this elasticity is NPR 111 per kilo with a **17.11 percent** change in the price level during the 15 year simulation period.

This sensitivity test demonstrates that a higher PE causes demand to change rapidly over time making price levels more sensitive and less volatile. This implies that a lower PE factor makes demand less volatile and considering the fact that demand doesn’t quickly change with a change in price, price levels changes frequently in the market. As demand in the Nepalese agricultural product market is inelastic, i.e., demand doesn’t promptly adopt to change in the price levels, this experiment further strengthens the assumption for the inelastic PE factor of .95 considered in the model.

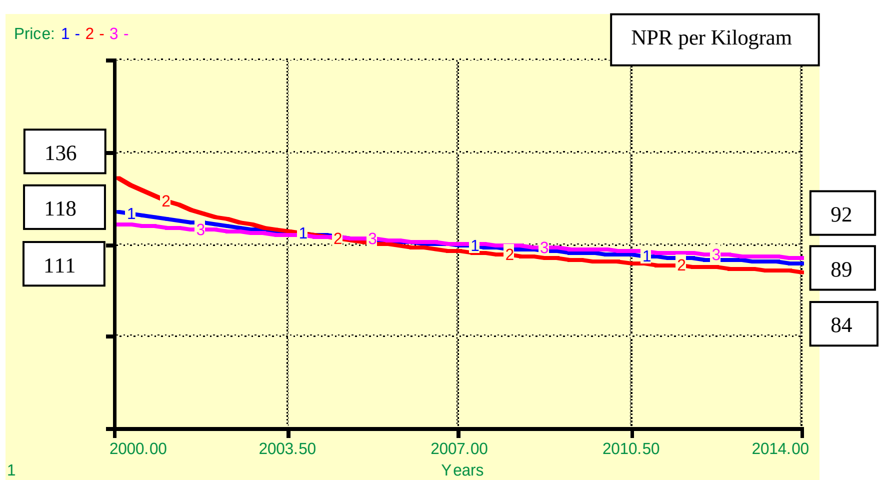

Figure 3.6. Sensitivity of PE on Po

3.3.6. Causality among Production, Price and Demand

In figure 3.7, the price level decreases and the production level increases over time as represented by 'Price 2' and 'Production 1' respectively. In the base year, when production is at 1.50 billion kilograms, aggregate price is NPR 118 per kilogram and as the production level rises to 2.38 billion kilograms in 2014, the price level falls down to NPR 89 per kilogram. This inverse relationship between P and Po clearly exhibits that a rise in production leads to economies of scale and increases efficiency in production. As a result, as costs are minimized with increasing economies of scale, price level goes down with an increasing production level. Furthermore, as demand is represented by P in the model, it can be said that a decreasing price level causes demand to rise and vice versa.

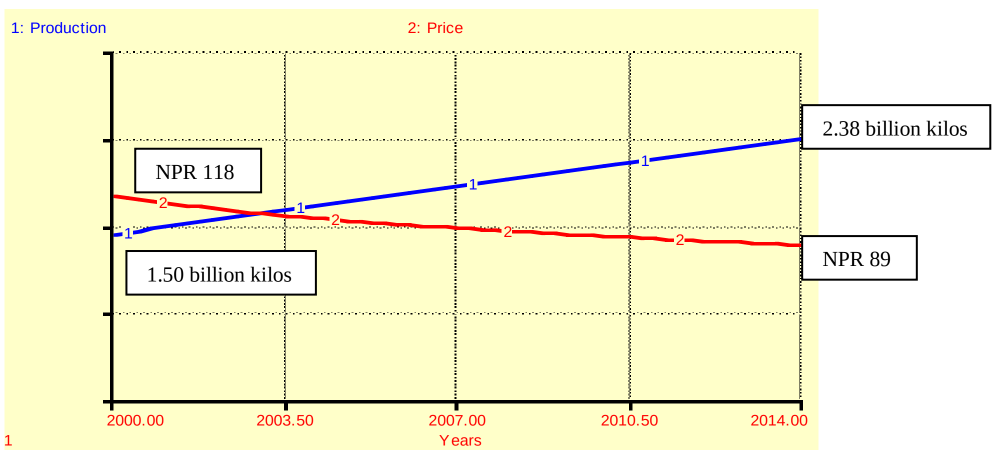

Figure 3.7. Causality between P and Po

3.4. Income (I)

'I' represents the total amount of monetary value generated in the Nepalese agriculture sector by summing up the entire production activities. Simply, it is the total revenue given by the entire Nepalese agriculture sector.

As mentioned in earlier section, the model doesn't incorporate the effects of inflation on the price level. Hence, the price level is expressed in real terms in the model. Despite a reasonable growth in P, with falling real price levels amidst increasing production levels, I grows steadily throughout the simulation period as given by 'Income 1' in figure 3.8. Figure 3.7 clearly explains the dynamics of P and Po and their combined effect on I resulting in a slowly growing real income levels during the reference period. As exhibited in the figure below, the real income in the Nepalese agriculture which stands to be NPR 176 billion in the base year exhibits a slow growth throughout the simulation period of 15 years. In 2014, the real income given by the Nepalese agriculture sector is NPR 211 billion.

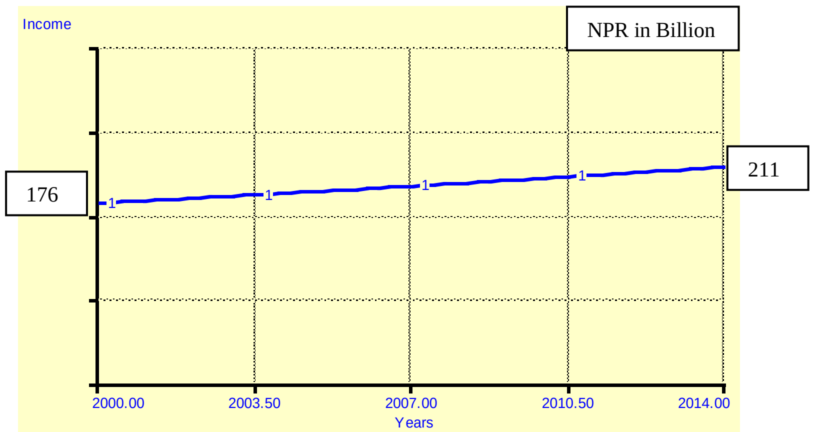

Figure 3.8. Real Income Level

The equation used to calculate I in the model is;

Income = Production*Price ***(Equation 3.4.1)***

(Refer to sections 3.2 and 3.3 for Production and Price respectively)

3.5. Net Income (NI)

NI represents total income in the Nepalese agriculture sector after adjusting or deducting all the incurred costs. In other words, it's the residual value of I after subtracting all the costs involved in the production process.

As exhibited in equation 3.5.1, NI is derived after deducting interest repayments and debt repayments from I. The equation used to compute NI in the model is exhibited by the equation 3.5.1.

NI which starts at NPR 121 billion in the base year shows a meager growth during the simulation period. The observed growth in NI is supported by a decreasing level of interest repayment as aggregate interest rate slowly goes down during the reference period. However, despite increasing debt repayment, NI in the Nepalese agriculture doesn't fall in real terms.

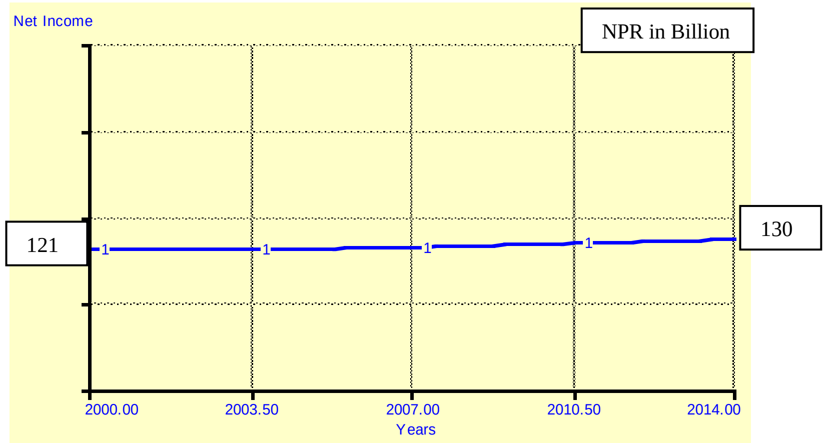

Figure 3.9. Net Income

Net Income = Income-Interest Repayment-Debt Repayment Rate ***(Equation 3.5.1)***

(Refer to section 3.4 for Income and section 3.11.2 for Debt Repayment Rate)

3.5.1. Interest Repayment (IRP)

IRP is the total amount of interest paid to the lenders of funds. In Nepal, the major sources of agricultural funds are from formal and informal sector. The formal sector is represented by banks and the informal sector represents individual creditors, mostly in rural areas. As used in equation 3.5.2, IRP is based on the total amount of debt as represented by 'Total Debt' and an interest rate as represented by 'Aggregate Interest Rate'. Increase in IRP decreases NI and vice versa. Furthermore, increase in total debt increases IRP and vice versa, ceteris paribus.

Interest Repayment = Total Debt*Aggregate Interest Rate ***(Equation 3.5.2)***

(Refer to sections 3.11 and 3.13 for Total Debt and Aggregate Interest Rate respectively)

3.6. Retained Earnings (RE)

In the model, RE represents the residual money with the households after domestic and all other operational expenses. RE is calculated by deducting all domestic or daily household expenses from NI.

Equation 3.6.1 is used to compute RE in the model.

Retained Earnings = Net Income*Propensity to Save ***(Equation 3.6.1)***

3.6.1. Propensity to Save (PS)

Propensity to save reflects the saving capacity of households after meeting all forms of expenses. Thus, when NI is multiplied with PS factor, we get RE.

On average, PS in the entire Nepalese economy is approximately 10 percent (Economic Survey, 2014). Since, the level of income in the Nepalese agriculture sector is below average income level, a PS factor of 5 percent is considered to compute RE in the model.

The equation for PE as used in the model;

Propensity to Save = 0.05 ***(Equation 3.6.2)***

3.7. Desired Capital (DC)

DC refers to the amount of total capital required to support the Nepalese agriculture sector in a most effective and efficient way. It could be understood as the best efficient level of capital to support the production. However, it is always not possible to have DC due to numerous financial constraints. For simplicity, DC is the sum of total capital mobilized and desired level of investment in the Nepalese agriculture sector.

In the Nepalese agriculture sector, DC plays a significant role. It exhibits the total amount of capital required to optimize production activities considering all the cost factors in the production process. In the model, interest rate and depreciation are used as the cost factors.

Equation 3.7.1 exhibits the formulation used to compute DC. The equation is derived by taking a first order derivative of the profit function in the model.

Desired_Capital =
((Capital_Exponent*Production*Price)/(Aggregate_Interest_Rate+Depreciation_Factor))

(Equation 3.7.1)

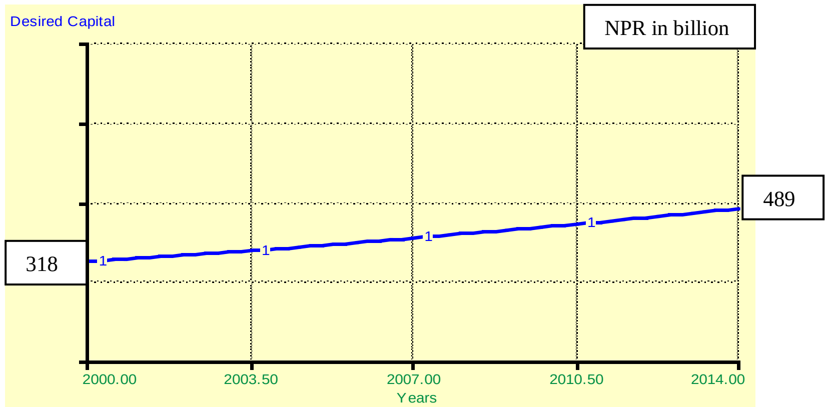

Figure 3.10. Desired Capital

In figure 3.10, the behavior of DC over the simulation period is exhibited. DC, which is NPR 318 billion in the base year grows in a steady state and reaches NPR 421 billion by the end of 2014. As P and interest rate are the key determinants of DC, increasing level of P (refer to figure 3.3) and falling 'Aggregate Interest Rate' (refer to section 3.13) can be attributed for the increasing level of DC over time. With an increase in P, the need for DC increases to support the increasing level of production activities. Furthermore, as the interest rate goes down over time, as given by AIR in the model, the demand for capital increases as capital becomes less expensive with falling interest rates, ceteris paribus.

3.7.1. Causality between Desired Capital and Aggregate Interest Rate

AIR, as represented by 'Aggregate Interest Rate 2' in figure 3.11, has a negative correlation with DC. When AIR is 20 percent in the base year, DC as exhibited by 'Desired Capital 1', is NPR 318 billion in the Nepalese agriculture sector. In the figure, it is clearly seen that a unit fall in AIR increases DC over time. In 2014, when AIR is 14 percent, DC stands to be NPR 489 billion. This clearly shows that there is an inverse relationship between AIR and DC. This implies that if AIR goes down, capital becomes cheaper and demand for capital rises, increasing DC in the Nepalese agriculture sector. Thus, lower the AIR, higher the DC and vice versa, ceteris paribus.

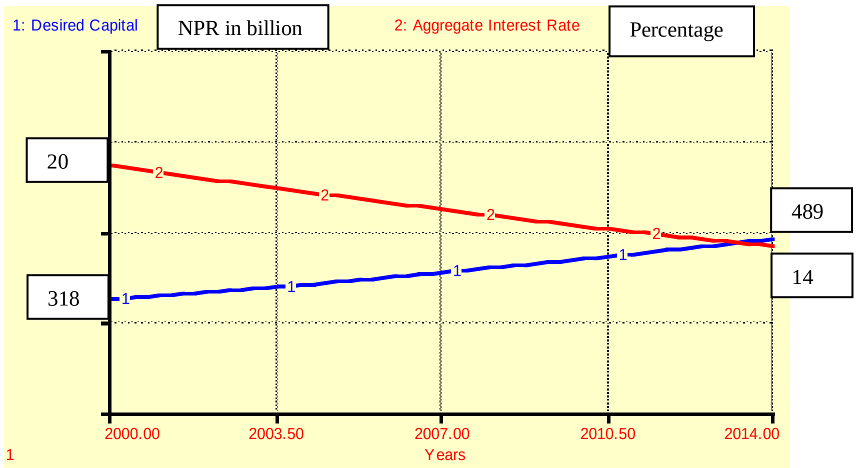

Figure 3.11. Effect of AIR on DC

3.8. Desired Investment (DI)

In the model, DI represents the total additional investment required in addition to the available capital, as represented by CM, in the Nepalese agriculture sector to support production efficiently. Principally, production can be fully functional if DI is fully financed, either by financial institutions or using personal funds.

Equation 3.8.1 clearly exhibits that DI is the difference between DI and CM. DI is primarily given by P and AIR, whereas, CM is given by the level of I. Furthermore, as the economy requires some time to realize the actual level of DI required, a small time interval as represented by 'Adjustment Interval' (AI) is used to show the time delay required to compute DI.

Desired_Investment = (Desired_Capital-Capital_Mobilized)/Adjustment_Interval

Equation (3.8.1)

3.8.1. Effect of Desired Capital and Capital Mobilized on Desired Investment

In figure 3.12, it is clearly seen that DI (Desired Investment 1) decreases from NPR 113 billion in the base year to NPR 91 billion in 2014. This implies that with time the level of required investment in the Nepalese agriculture sector is decreasing. The prime cause for falling DI is increasingly increasing CM (Capital Mobilized 3) compared to the increase in demand for DC (Desired Capital 2). This means, the growth rate of CM is much higher than the growth rate of DC during the simulation period of 15 years. In the figure below, DC only grows by approximately 54 percent, while, CM increases by 96.5 percent during the fifteen years. Thus, the difference in the growth rates of CM and DC, with the growth rate of CM being higher, results in decreasing DI in the Nepalese agriculture sector.

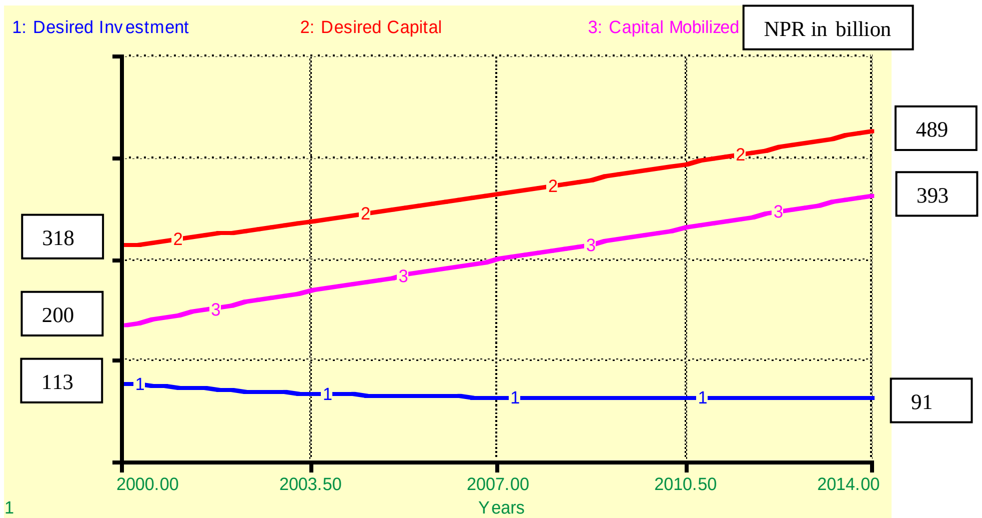

Figure 3.12. Effect of DC and CM on DI

3.9. Desired Borrowing (DB)

DB stands for the total amount of credit desired from the formal and informal lending sector in the Nepalese agriculture sector. The level of DI and RE determines the amount of DB. Higher the DI, higher the DB and higher the RE, lower the DB and vice versa, ceteris paribus. This relationship is explained by equation 3.9.1. This implies that if the income level of household increases, the agriculture sector becomes more reliant on income rather than on credit, thus, reducing desire for borrowing.

Figure 3.13 exhibits the behavior of DB over time in response to DI and RE as represented by trajectories ‘2’ and ‘3’ respectively. DB, as represented by line ‘1’, decreases over time from NPR 107 billion to NPR 84 billion as a result of decreasing DI and meagerly increasing RE.

Desired_Borrowing = Desired_Investment-Retained_Earnings ***(Equation 3.9.1)***

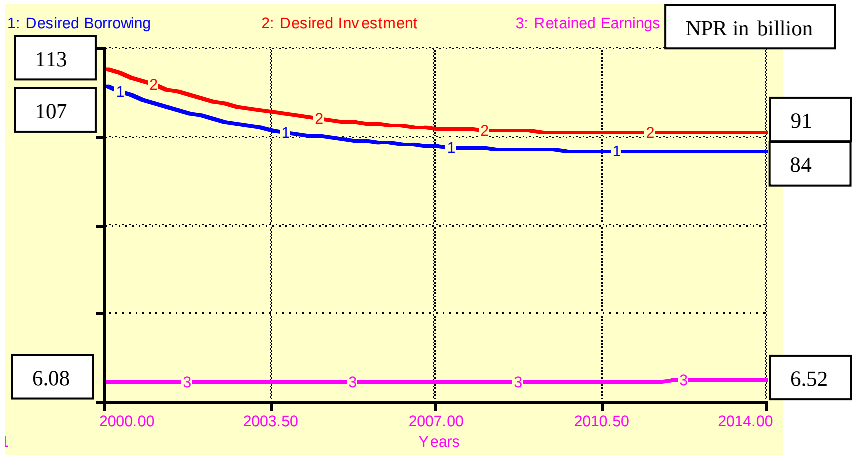

Figure 3.13. Effect of RE and DI on DB

3.10. Maximum Allowable Loan (MAL)

In the model, MAL represents the ceiling or maximum amount of credit that can be availed by the aggregate agriculture sector in Nepal. MAL purely relies on RE and AIR. Higher RE results in higher MAL and lower AIR causes MAL to rise. This implies that any increase in savings, as represented by RE, and fall in the aggregate interest rate in the economy, as represented by AIR, increases borrowing capacity of the agriculture sector. This relationship is explained by equation 3.10.1.

Maximum_Allowable_Loan = (Retained_Earnings/Aggregate_Interest_Rate)

(Equation 3.10.1)

Figure 3.14, clearly shows that MAL, as represented by line '1', increases from NPR 30 billion to NPR 47 billion during the simulation period with the falling interest rate. AIR represented by line '3' in the figure falls from 20 percent in the base year to 14 percent in 2014. Furthermore, slightly increasing RE (line '2') has also contributed to the increasing MAL.

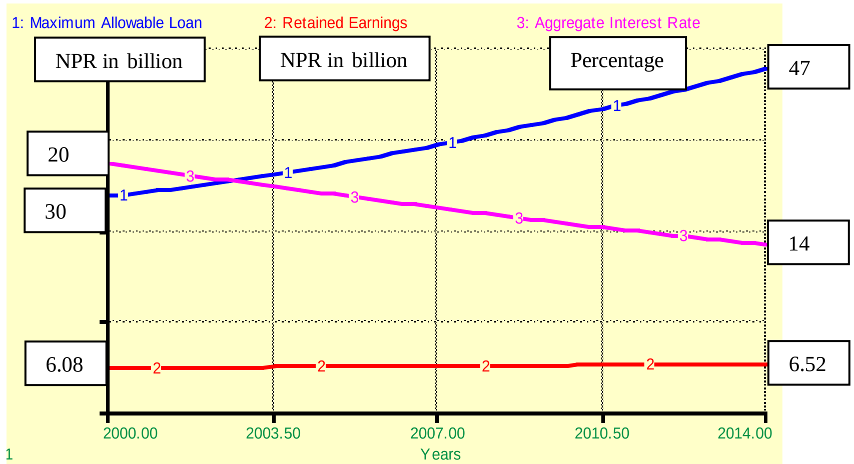

Figure 3.14. Effect of RE and AIR on MAL

3.11. Total Debt (TD)

TD stands for the total amount of outstanding credit in the formal and informal lending system. The formal lending sector is represented by banks and financial institutions, whereas, the informal lending sector comprises of individual creditors. Figure 3.15 exhibits the structure for TD as used in the model.

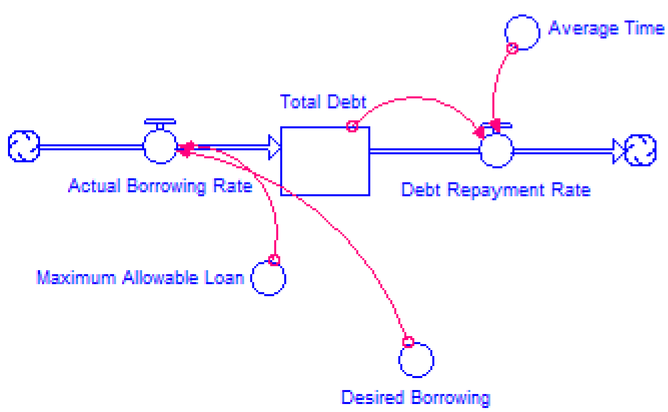

Figure 3.15. SFD of TD with its Flows and respective determinants

Equation 3.11.1 shows the components of TD in the model and equation 3.11.2 represents the initial value of TD in the Nepalese agriculture sector, which stands to be NPR 180 billion in the base year. As actual data for the initial value of TD is not available, the initial value is calibrated using other variables in the model. The components of TD are explained hereafter.

Total_Debt(t) = Total_Debt(t - dt) + (Actual_Borrowing_Rate - Debt_Repayment_Rate) * dt

(Equation 3.11.1)

INIT Total_Debt = 180,000,000,000 ***(Equation 3.11.2)***

3.11.1. Actual Borrowing Rate (ABR)

ABR is the inflow for TD which increases its value over time. It refers to the yearly amount of financing received by the Nepalese agriculture sector. As exhibited by equation 3.11.3, ABR is the minimum of either DB or MAL (Refer to sections 3.9 and 3.10 for DB and MAL respectively).

Actual_Borrowing_Rate = Min(Desired_Borrowing,Maximum_Allowable_Loan)

(Equation 3.11.3)

3.11.2. Debt Repayment Rate (DRR)

DRR is the outflow of TD in the model. It decreases the value of TD over time. It refers to the yearly amount of debt settlement or repayment made by the households in the Nepalese agriculture sector. DRR is simply calculated by dividing TD by 'Average Time' (AT), which represents the average financing period of households. As credit facilities are settled as early as possible in the Nepalese community, especially in the rural communities, the model assumes an average time period of 10 years for loan duration in the Nepalese agriculture sector. Equation 3.11.5 exhibits AT as used in the model.

Debt_Repayment_Rate = Total_Debt/Average_Time ***(Equation 3.11.4)***

Average_Time = 10 ***(Equation 3.11.5)***

3.11.3. Causality of Actual Borrowing Rate and Debt Repayment Rate on Total Debt

The accumulation or development of TD depends upon the net flow of ABR and DRR. TD increases if ABR is greater than DRR and vice versa. As the contribution of ABR is higher than that of DRR, the growth of TD from NPR 180 billion in the base year to NPR 341 billion in 2014 is justified. Thus, ABR and DRR are positively and negative correlated respectively with TD.

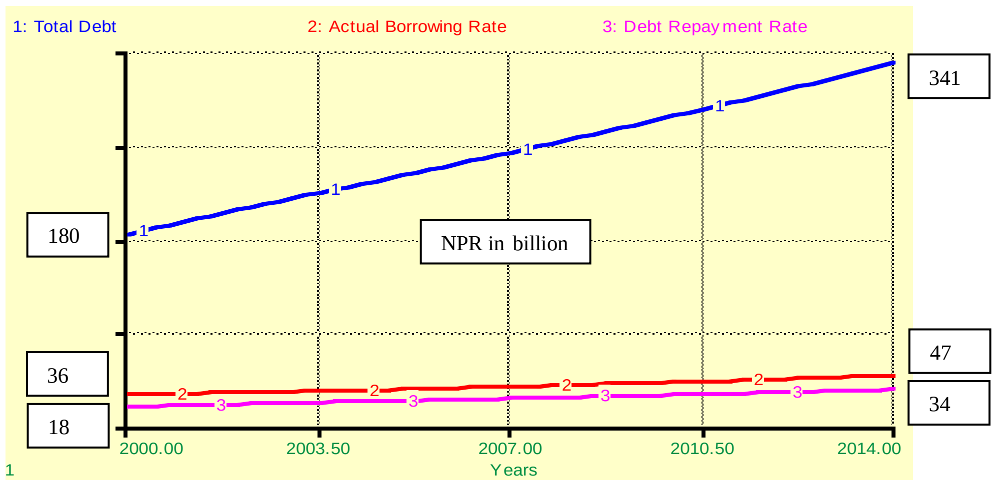

Figure 3.16. Behavior of TD with respect to the Inflow, ABR and the Outflow, DRR

3.12. Formal Banking Market Share (FBMS)

FBMS represents the presence of formal banking system available for the Nepalese agriculture sector in a countrywide scope. The presence of formal banking sector facilitates credit opportunities to households at cheaper interest rates compared to informal financing. It promotes growth in the agriculture sector by providing financing to procure machineries, tools and equipment, fertilizers and other required investment in the sector. Generally, growing FBMS makes credit market more competitive, attractive and affordable to the agriculture sector.

Equation 3.12.1 exhibits the mathematical derivation used to calculate FBMS in the model. Change in FBMS results from 'Change in Market Share' (CMS) which causes FBMS to grow over time. Considering a report on 'National Sample Census of Agriculture' (Central Bureau of Statistics, 2013), which states a 8 percent presence of the formal banking in the Nepalese agriculture sector in 2012, a market share of 2 percent is assumed in the model in the base year as exhibited by equation 3.12.2.

Formal_Banking_Market_Share(t) = Formal_Banking_Market_Share(t - dt) +
(Change_in_Market_Share) * dt ***(Equation 3.12.1)***

INIT Formal_Banking_Market_Share = 0.02 ***(Equation 3.12.2)***

3.12.1. Model's Behavior and Reference Mode

The behavior of FBMS as given by the model, as exhibited in figure 3.17, shows an increasing trend during the simulation period. FBMS, which stands to be only 2 percent in the base year, grows to 10 percent by the end of 2014. This clearly shows that banking access in the Nepalese agriculture sector is increasing.

The growth rate driven by the model stands to be appropriate as the fraction of formal banking in the Nepalese agriculture sector, as per the national report of the Central Bureau of Statistics, is also 8 percent in 2012. This is exactly the same fraction as given by the model simulation in 2012. The point of intersection of the actual data and the model simulation (8 percent) is highlighted in the figure below.

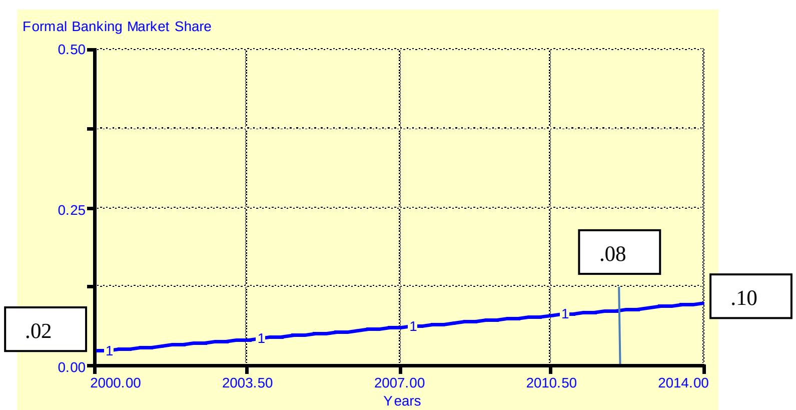

Figure 3.17 Market Share of Formal Banking Sector

3.12.2. Change in Market Share (CMS)

CMS is the inflow to FBMS in the model. It changes the behavior of FBMS over time. Higher the CMS, higher the growth rate of FBMS and vice versa. If CMS is extremely low, it causes FBMS to grow at a very slow rate. The change in market share of formal banking in the Nepalese agriculture sector is given by 'Desired Market Share' (DMS), FBMS and 'Fiscal Implementation on Expansion' (FIE).

Equation 3.12.3 exhibits the derivation of CMS in the model. Higher the DMS, higher the CMS and lower the FBMS, higher the CMS and vice versa, ceteris paribus. . Furthermore, longer FIE period decreases the rate of CMS and vice versa.

Change_in_Market_Share = (Desired_Market_Share-Formal_Banking_Market_Share)/Fiscal_Implementation_on_Expansion (Equation 3.12.3)

3.12.2.1. Desired Market Share (DMS)

DMS represents the total required presence of the formal banking sector in the Nepalese agriculture sector. The desired market share is based on the concept of market demand for agricultural financing. Equation 3.12.4 explains the concept used to derive DMS in the model.

The difference of DC and CM shows a slack in financing and the demand for financing persists in the agriculture sector. Thus, higher the DC, higher is DMS and as the level of CM increases in the sector, the requirement of financing decreases causing DMS to fall.

Furthermore, the level of I plays a significant role in determining the level of DMS in the Nepalese economy. The concept of I in determining DMS is that when income increases, households have sufficient capital and an increase in savings. This leads to fall in demand for capital or financing from banking sector and vice versa. Thus, as higher I increases self-sufficiency in the agriculture sector, it decreases the demand for financing and hence, decreases DMS and vice versa.

Desired_Market_Share = (Desired_Capital-Capital_Mobilized)/Income (Equation 3.12.4)

3.12.2.2. Fiscal Implementation on Expansion (FIE)

FIE in the model is presented as an aggregate indicator for the average time required for the formal banking expansion in a countrywide level, as considered by the government of Nepal. As mentioned earlier, longer FIE is considered to be unfavorable for FBMS as it slows down the rate of CMS.

In equation 3.12.5, it is clearly seen that an increase in the level of CM reduces FIE. In the model with ‘Fiscal Policy Focus’ (FPF) being a constant, as the growth rate of CM is much higher than that of NI, which is presented in real terms, FIE period decreases over time. This implies that the time required for the banking expansion is decreasing. With every fall in FIE, the number of bank and financial institutions increases, increasing banking access.

Policy_Review = (Net_Income/Capital_Mobilized)/Fiscal_Policy_Focus ***(Equation 3.12.5)***

3.12.2.2.1. Fiscal Policy Focus (FPF)

In the model, FPF is used as a representative of Nepal's Fiscal Policy's focus on expansion of banking access or rural banking as a percentage of total fiscal budget. The weight given to FPF in the model is an approximate percentage of the yearly budgets of Nepal, which stands to be 0.5 percent. The basis for assigning this weight to FPF in the model is the level of aggregate focus on the 'Budget Speech 2014/15' (Ministry of Finance, 2014), the fiscal policy of Nepal, given for the agriculture sector in Nepal. As the policy hasn't precisely allocated funds for banking expansion, the fraction of FPF used in the model is a representative for the policy's effort to improve the Nepalese agriculture sector. The focus for rural banking expansion dedicated to the agriculture sector is similar in the past. Thus, the weight, a constant during the simulation period, is an approximate indicator of the budget's appropriation dedicated to the banking access in the agriculture sector. Equation 3.12.6 exhibits FPF as used in the model.

Fiscal_Policy_Focus = 0.005 ***(Equation 3.12.6)***

3.13. Aggregate Interest Rate (AIR)

AIR is one of the most important variables in the model as we state a hypothesis that lack of effective financial structure, which includes interest rate, causes slow agriculture growth. AIR represents the average interest rate in the Nepalese agriculture sector considering both formal and informal financing systems. Formally regulated banking sector comes under the formal banking system, whereas, private lending/borrowing falls under the informal financing system. As the informal financing is not regulated, interest rates charged in informal transactions are much higher than in the formal financing system. According to a research by Hatlebakk (2009), households in the Nepalese agriculture sector pay up to 50 percent real interest rate to private creditors in the informal credit market. However, as the formal sector is regulated by the central bank of Nepal, Nepal Rastra Bank, interest rates are more competitive. For instance, according to a meta-data (macro-economic data) published by the central bank of Nepal, aggregate real interest rate in Nepalese banking sector in 2000 AD was approximately 5 percent.

3.13.1. Simulation Behavior of AIR and Banking in Nepal

Figure 3.18 exhibits that AIR in the Nepalese agriculture sector decreases from 20 percent in the base year to 14 percent in 2014. The study hypothesizes that inefficiency in banking sector increases interest rate which slows down the growth rate in the agriculture sector. Validating the hypothesis, as the number of banks increase in the Nepalese banking industry, AIR goes down. For instance, when there were only 14 commercial banks in Nepal in the base year, i.e., 2000, AIR stood to be 20 percent. In 2014, with 30 commercial banks (Nepal Rastra Bank, 2014); AIR in the Nepalese agriculture sector was approximately 14 percent. This strongly supports the hypothesis that increase in banking access reduces interest rates and increases productivity in the economy (refer to section 3.2).

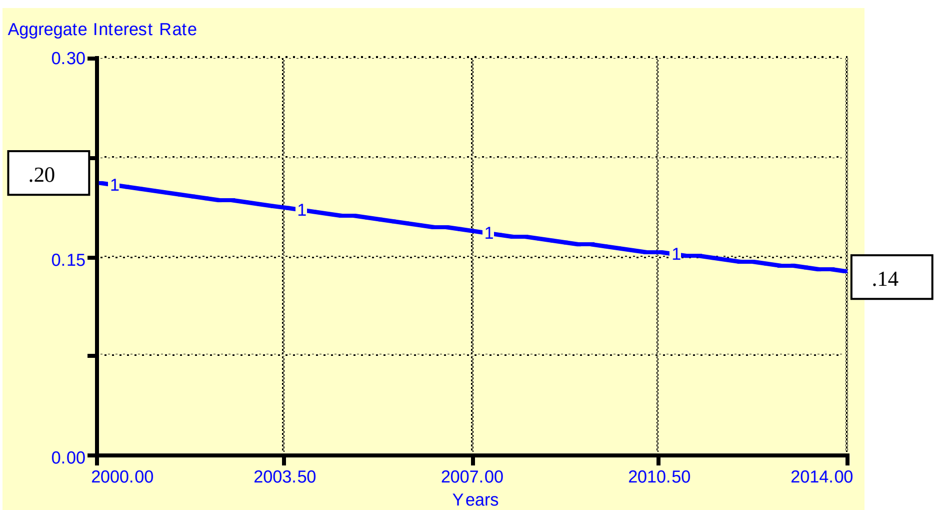

Figure 3.18. Behavior of AIR over time

The derivation of AIR in the model is given by equation 3.13.1.

Aggregate_Interest_Rate = Max(.02,(Actual_Interest_Rate*Limited_Formal_Sector_Market_Share+Informal_Sector_Interest_Rate*Informal_Sector_Market_Share)/(Limited_Formal_Sector_Market_Share+Informal_Sector_Market_Share)) ***(Equation 3.13.1)***

Equation 3.13.1 used to compute the value of AIR makes sure that the value never falls below 2 percent. Since, ‘Max’ condition is used; the equation takes maximum of either 2 percent or the value computed by the second part of the equation. Thus, a minimum interest rate of 2 percent is assumed to be viable for the Nepalese agriculture sector considering interests of both households and banking sector. However, AIR is determined by the second part of the equation.

3.13.2. Limited Formal Sector Market Share (LFSMS)

LFSMS refers to the share of formal banking in the Nepalese agriculture sector excluding the presence of informal sector. Equation 3.13.2 in the model makes sure that total market share of formal and informal sector, when combined, at maximum never exceeds 100 percent.

(Refer to section 2.12 for FBMS)

Limited_Formal_Sector_Market_Share = Min(Formal_Banking_Market_Share,(1-Informal_Sector_Market_Share)) ***(Equation 3.13.2)***

(Note: In the model, when the policy for formal banking market share is activated, ‘Formal Banking Market Share Policy’ is activated in place of ‘Formal Banking Market Share’)

3.13.2.1. Informal Sector Market Share (ISMS)

In the model, ISMS represents the total coverage of informal lending in the Nepalese agriculture sector. As explained earlier, informal lending comprises of private credits to households at higher interest rates. According to a national survey (Central Bureau of Statistics, 2013), the coverage of informal lending in Nepalese agriculture sector stands to be 17 percent in 2012 AD. Thus, considering lack of other data sources and legitimate information on informal lending, a constant 17 percent is used in the model to represent ISMS in the model. Equation 3.13.3 exhibits ISMS as used in the model.

Informal_Sector_Market_Share = 0.17 ***(Equation 3.13.3)***

3.13.3. Actual Interest Rate (AIRo)

AIRo represents the effective interest rate, based on the availability of collateral, in formal banking sector for the agriculture sector in Nepal. Sufficiency in collateral reduces risk to banking sector, hence, decreases interest rates. AIRo is solely based on 'Bank Interest Rate' (BIR) and 'Collateral Adequacy' (CA).

Equation 3.13.4 explains that if CA increases, AIR decreases and vice versa.

Actual_Interest_Rate =
bank_interest_rate/(if(Collateral_Adequacy<.5)then(.5)else(min(Collateral_Adequacy,5)))

(Equation 3.13.4)

3.13.3.1. Bank Interest Rate

In the model, BIR refers to the general real interest rate in the Nepalese banking sector. A real BIR of 8 percent is considered in the model based on published interest rates of various banks in the Nepalese banking sector. The BIR of 8 percent in the model, which is used as a proxy, is based on an observation of interest rates of 219 licensed banks and financial institutions in the Nepalese banking sector (Nepal Rastra Bank, 2014).

Equation 3.13.5 exhibits BIR as used in the model.

Bank_Interest_Rate = 0.08 ***(Equation 3.13.5)***

*(Note: The equation for BIR is '**Bank_Interest_Rate = if(time>2014)and(Interest_Rate_Policy_Switch>0)then(Policy_for_Bank_Interest_Rate)else(0.08)**,' when the policy for BIR is activated in the model)*

3.13.3.2. Collateral Adequacy

CA in the model represents the sufficiency of CM compared to TD in the Nepalese agriculture sector. Higher CM results in higher CA and higher TD decreases CA. It is simply the ratio of total capital and total debt as represented by CM and TD respectively. For banks and financial institution, CA plays an important role in determining interest rates. Higher CA means less risk and subsequently lower interest rate. Generally, CA greater than 1 is considered to be safe in banking as it shows that level of asset or capital is higher than level of debt or credit.

In figure 3.19, CA is represented by trajectory '1' which is expressed in terms of 'times.' Here, CM as represented by trajectory '2' increases by approximately 97 percent during the simulation period, whereas, TD as represented by trajectory '3', increases only by an approximate 70.5 percent. As the growth rate of CM is excessively higher than that of TD, CA increases from 1.11 times to 1.15 times during the period of 15 years. This implies that the Nepalese agriculture sector has a positive net worth. Increasing CA, with decreasing default risks, is also one of the prime reasons behind gradually falling interest rates in the Nepalese agriculture sector.

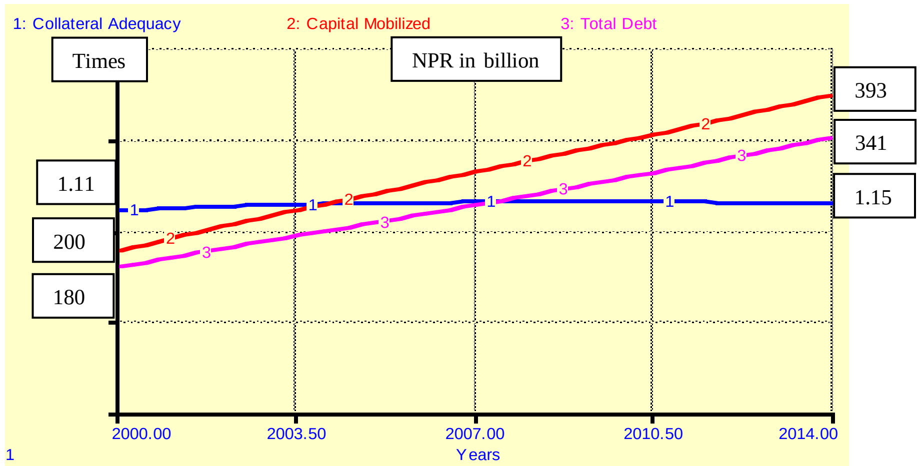

Figure 3.19. Causality of CM and TD on CA

Equation 3.13.6 exhibits the computation of CA in the model.

Collateral_Adequacy = (Capital_Mobilized/Total_Debt) ***(Equation 3.13.6)***

3.13.4. Informal Sector Interest Rate (ISIR)

ISIS refers to prevailing real interest rates in the informal financing system in the Nepalese agriculture sector. Interest rates charged by private creditors are extremely high, sometimes, up to a real interest rate of 50 percent. However, in the model, a real interest rate of 22 percent is assumed in the base year. The base for assuming this rate is gradually decreasing interest rate in the formal banking sector. ISIS is always higher that interest rate in the formal banking system, however, the correlation of these rates is always positive. This implies, if interest rates in formal banking fall, ISIS also decreases and vice versa. Figure 3.20 exhibits the trend of ISIR, as represented by line '1'. With gradually falling AIR (refer to section 3.13.4), ISIR gradually falls from 22 percent in the base year to 18 percent by the end of 2014.

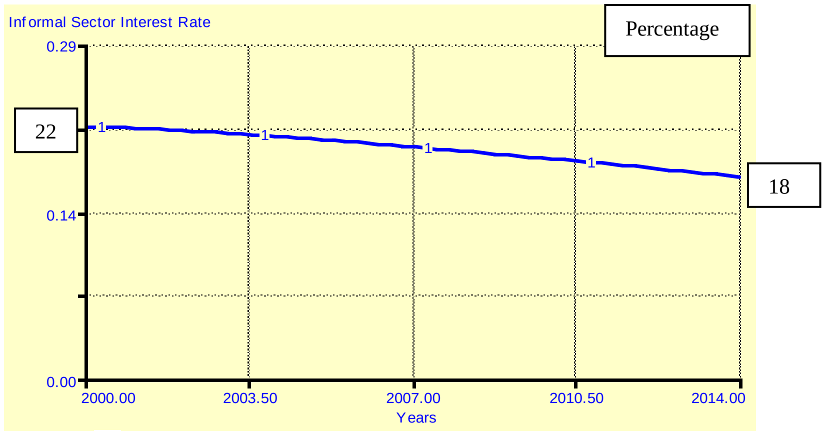

Figure 3.20. Interest Rate in Informal Sector

Equation 3.13.7 exhibits the derivation for ISIR and equation 3.13.8 is an expression for the initial value of ISIR (base year value) as used in the model.

Informal_Sector_Interest_Rate(t) = Informal_Sector_Interest_Rate(t - dt) + (Interest_Rate_Adjustment) * dt ***(Equation 3.13.7)***

INIT Informal_Sector_Interest_Rate = 0.22 ***(Equation 3.13.8)***

3.13.4.1. Interest Rate Adjustment (IRA)

IRA is the multi-flow to ISIR which either increases or decreases the value of ISIR in the model. IRA is positive if AIR is greater than ISIR and hence increases the value of ISIR and vice versa. IRA represents an adjustment to interest rates in the informal financing sector. Once interest rates in the formal banking sector starts to fall, interest rates in the informal financing sector also decreases with some time delay. Equation 3.13.9 exhibits the derivation of IRA in the model.

Interest_Rate_Adjustment = (Aggregate_Interest_Rate-Informal_Sector_Interest_Rate)/Adjustment_Period ***(Equation 3.13.9)***

3.13.4.2. Adjustment Period (AP)

AP represents time lag for the effect of AIR to be seen on IRIS. The time delay is represented by equation 3.13.10. A time delay of 10 years is considered in the model. Generally, it takes a long time to show the effect of a fall in interest rates in the formal banking sector on the informal financing sector. The realization period for a fall in interest rate in the formal banking sector on the informal banking sector is extremely high in Nepal. Thus, 10 years is considered to be a reasonable time period to show the effect of AIR on ISIR.

Adjustment_Period = 10 ***(Equation 3.13.10)***

3.14. Model Behavior and Comparison with the Reference Mode

In figure 3.21, 'Simulation 1' (S1) represents the model's behavior over the simulation period of 15 years. In the model, S1 refers to total contribution of the Nepalese agriculture sector to GDP of Nepal. It is named as 'Contribution of the Agriculture sector to GDP' in the model. On the other hand, 'Data 2' (D2) in the figure below exhibits the real figures of contribution of the agriculture sector to GDP.

As exhibited in the figure, both S1 and D2 are NPR 150 billion in the base year. By the end of 2014, both S1 and D2 stand to be NPR 238 billion. Throughout the simulation period of 15 years, only a maximum deviation of approximate 5 percent is observed between S1 and D2. The behavior of S1 exhibits the accuracy of the model in terms of replicating the actual data points of contribution of the agriculture sector to GDP in Nepal.

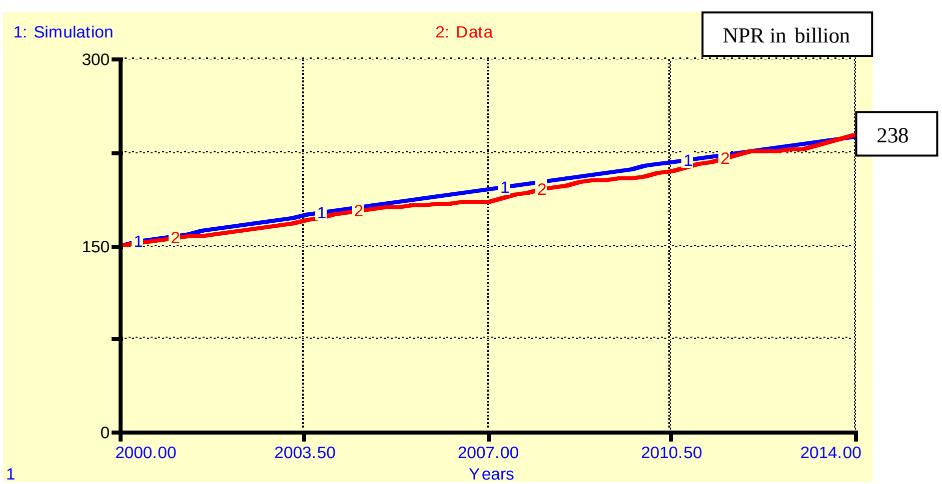

Figure 3.21. Model Simulation versus Reference Behavior

3.15. Goodness of the Hypothesis (Model)

In the study, we state a hypothesis that lack of effective and efficient financing structure causes slow agriculture growth. Upon testing the model, both partially and at an aggregate level, the causality of financing system, as represented by FBMS and AIR, is extremely sensitive on P (also represented by S1 in figure 3.21, real contribution of the agriculture sector to GDP). Based on various sensitivity tests, the reliability and accuracy of the model is believed to be extremely high. The model simulation, with only a maximum deviation of approximate 5 percent compared to the reference mode (D1), exhibits that the model represents the stated hypothesis. Hence, the model is believed to have passed 'The Goodness of Fit' test.

3.16. Appropriateness of the Model for Policy Testing

The model, in combination of multiple calibration, real data points and some assumptions, successfully replicates the reference behavior of the Nepalese agriculture sector (refer to section 3.14). With a confidence interval of an approximate 95 percent, the model exhibits tremendous strength in terms of replicating the historic behavior in the Nepalese agriculture sector in terms of production. Furthermore, based on various sensitivity tests, the robustness of the model is proven. It implies that the model generates realistic picture of the Nepalese agriculture sector and associated financing system. Considering the goodness of the hypothesis, i.e., fit of the simulation behavior with the reference mode, the model is considered an appropriate platform for policy tests.

4. Policy Design and Implementation

The government of Nepal has been focusing to promote formal banking in the rural areas of Nepal to foster the agriculture sector. Various provisions, concerning rural banking for the agriculture sector, are set in monetary and fiscal policies. Despite the government's attempt to grow the agriculture sector in Nepal, the realized progress over the last decade has not been satisfactory. The central bank of Nepal, Nepal Rastra Bank, requires banks to open at least two branches or operating units outside the capital city, Kathmandu, before they can operate a new branch unit in the capital. This provision, however, supports the government's goal to achieve a prosperous and sustainable agriculture sector; the progress has not been satisfactory so far.

4.1. Policy Propositions

The study states a hypothesis that lack of effective and efficient financing mechanism, incorporating high interest rates, results in slow agriculture growth. The analysis of this hypothesis in the preceding chapter of this study validates the stated hypothesis. In line with the significance of formal banking access and interest rates for overall well-being of the agriculture sector in Nepal, the policies focus on banking sector expansion and adjustment of market interest rates.

4.1.1. Policy A-Expansion of Formal Banking Market Share

With current focus of the government of Nepal on expansion of formal banking, the access of formal banking to the rural population is not satisfactory. In 2014, approximately 10 percent of households/farmers had access to the formal banking sector in Nepal. This clearly shows that the Nepalese agriculture sector immediately requires a radical shift in expansion of the formal banking sector. The policy option on formal banking expansion is proposed taking into account the insufficiency of banking access to the rural areas in Nepal.

Equation 4.1 exhibits the equation for Policy A, Expansion of Formal Banking Market Share as used in the model:

Policy_for_Formal_Banking_Market_Share = 0.4 ***(Equation 4.1)***

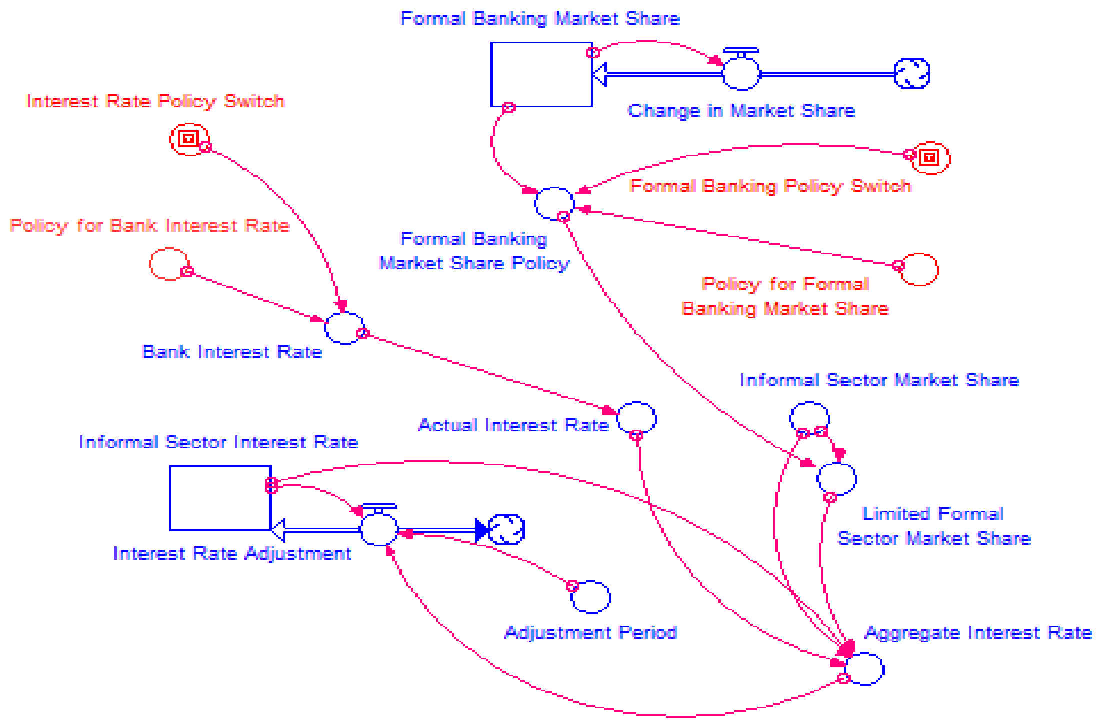

Figure 4.1. A Structural Representation of Policy A, Formal Banking Market Share and Policy B, Bank Interest Rate, in the Model

(Note: In figure 4.1, variables marked as red are policy variables and switches)

As used in the model, 'Policy for Formal Banking Market Share' is a policy option that accounts the market share of formal banking sector as **40 percent**. It implies that after 2014 the share of formal banking sector is 40 percent in the Nepalese agriculture sector. This is simply a scenario test policy which gives ground for further policies. This radical shift of FBMS to 40 percent is tested to evaluate the pure effects of rural banking expansion on the agriculture sector in Nepal. This test identifies the importance of formal banking sector and creates awareness among the related stakeholders in the Nepalese agriculture sector. Based on the results of this test, the stakeholders of the Nepalese agriculture sector, like the Government of Nepal, farmers/households and banks and financial institutions, can take corrective actions towards strengthening the access of formal banking sector.

Figure 4.2 exhibits the effect of policy of increasing the share of FMBS to 40 percent after 2014. By increasing FMBS, as represented by 'Policy Run 2', the contribution of the agriculture sector rises to NPR 422 billion from the base scenario of NPR 412 billion, as represented by 'Base Run

1', by the end of 2040. Rise in the market share of formal banking attracts households, as aggregate interest rates in the formal banking sector become relatively lower. This increases financing and investment opportunities in the agriculture sector, eventually, increasing capital and production. This increase in contribution of the agriculture sector to GDP of Nepal shows that expansion of formal banking in rural areas increases productivity in the agriculture sector. Furthermore, with the increase in rural banking, beyond rise in the aggregate production level, the Nepalese agriculture sector enjoys increased income, saving, efficiency in production and shared knowledge in the sector. All these factors further strengthen the productivity, which are not incorporated in the model.

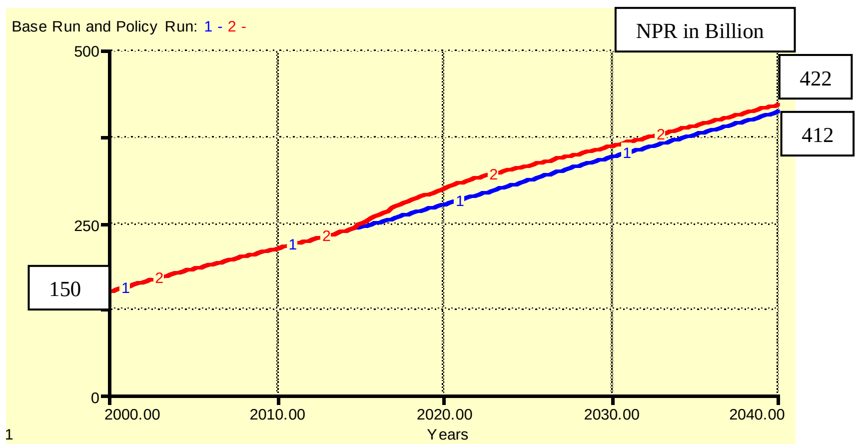

Figure 4.2. Contribution of Agriculture Sector to GDP

4.1.2. Policy B-Reducing Bank Interest Rate

From the analysis of the stated hypothesis in the model, it is evident that interest rate has huge impact on the agriculture sector productivity in Nepal. Higher the BIR, lower the production and vice versa. Higher interest rates discourage households to avail financing as they lack repayment capacities. In Nepal, an aggregate nominal interest rate of 18 percent, as used in the model, is considered extremely high compared to interest rates in the developed world. Households availing financing facilities, however, are obliged to pay higher interest rates. This lowers their real output and reduces efficiency in the agriculture sector. Considering the sensitivity of BIR on the agriculture sector in Nepal, the second policy proposition in the study is to lower BIR by 300 basis points to **5 percent** real interest rate (refer to section 3.13.4.1 for BIR).

Equation 4.2 exhibits the equation for Policy B, Bank Rate, as used in the model.

Policy_for_Bank_Interest_Rate = 0.05 ***(Equation 4.2)***

In figure 4.3, as represented by 'Base Run 1', the contribution of the agriculture sector to GDP is NPR 412 billion by the end of 2040. This implies that if no policies are exercised, the contribution of the Nepalese agriculture sector to GDP would be NPR 412 billion in 2040. The analysis in the study supports the hypothesis that lower interest rate increases production in the agriculture sector and vice versa. Hence, by exercising the policy of lowering BIR to 5 percent, the productivity in the Nepalese agriculture sector increases by approximately 8 percent compared to the situation where no policy is exercised. The contribution of the agriculture sector, by the end of 2040, rises to NPR 444 billion by lowering BIR by 300 basis points as exhibited by trajectory 2 in figure 4.3. Hence, reducing BIR to 5 percent from existing 8 percent level results in a satisfactory trajectory of the Nepalese agriculture sector.

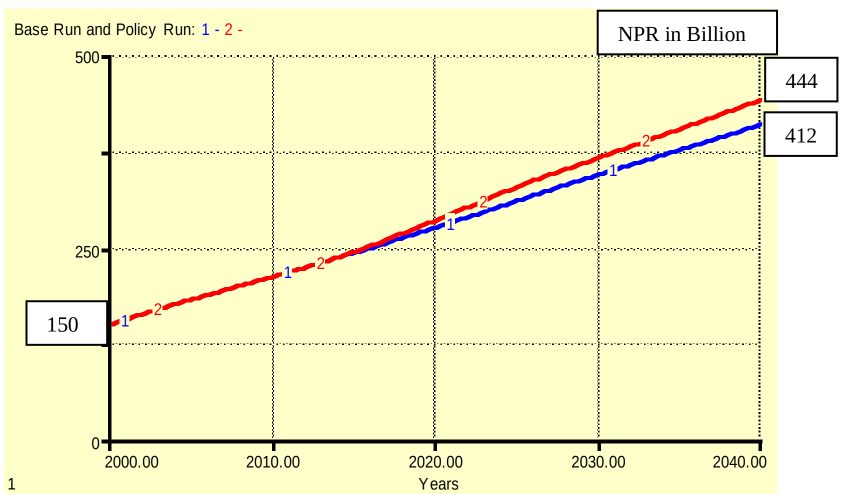

Figure 4.3. Sensitivity of BIR on Contribution of Agriculture Sector to GDP

4.2. Simultaneous Sensitivity Tests of Policy A and Policy B on Production

Figure 4.4 exhibits the effects of policies on the behavior of contribution of the agriculture sector to GDP (refer to section 3.14). The figure is divided in four sub-sections, A, B, C and D. The trajectory in figure A represents the development of the Nepalese agriculture sector when no policy is exercised. The contribution of the Nepalese agriculture sector for this condition is NPR 412 billion by the end of 2040. As discussed in section 4.1.1, figure B exhibits the influence of Policy A. Similarly, as discussed in section 4.1.2, figure C shows the effect of Policy B on the Nepalese agriculture sector productivity from 2015 to 2040. Finally, figure D summarizes the effects of both the policies, Policy A and Policy B, which significantly increases the contribution of the agriculture sector to GDP of Nepal. With the combined policy, the output in the agriculture sector by the end 2040 is NPR 458 billion. This is an approximate 11.5 percent rise in the productivity in the Nepalese agriculture sector compared to the situation when no policy is exercised.

By exercising policy A, the access of formal banking significantly surges to the rural agriculture sector. This gradually reduces interest rates and makes financing viable for households. With adequate and cost-efficient financing, the productivity of the agriculture sector rises. Similarly, by exercising Policy B, as aggregate BIR goes down, the repayment capacity of the agriculture sector increases. This substantially increases borrowing capacity of the farming sector. Increased borrowing increases investment, which increases capital, as represented by CM in the study. As a result, with increased capital, production level grows increasing output in the agriculture sector.

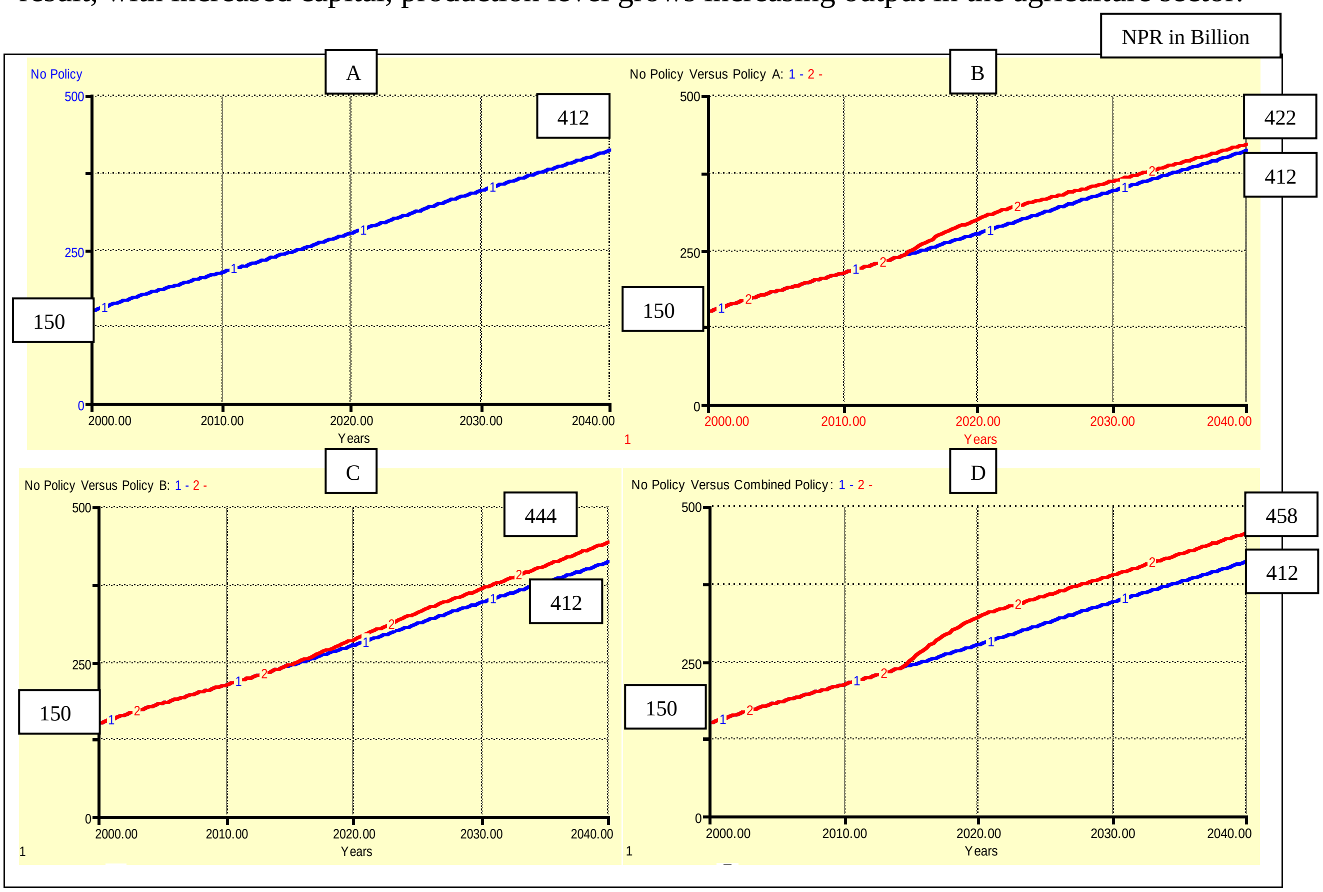

Figure 4.4. Sensitivities of Policies on Contribution of the Nepalese Agriculture Sector to GDP

The proposed policies have positive impact on the agriculture sector in Nepal. These policies help to grow the agriculture sector and enhance the aggregate agriculture eco-system in Nepal. The study, however, only focuses on output in the agriculture sector, increase in agricultural efficiency, productivity, and technological advancement are other factors which realizes improvements with an improved and cost efficient financing access.

4.3. Implementation

The government of Nepal uses fiscal and monetary policies to address macro-level policy requirements. The policies are proposed taking into account the compatibility of the proposed policies with fiscal and monetary policy tools. Policy A, which focuses on increasing access of formal banking to the rural agriculture sector to 40 percent, is addressed by fiscal policy. Similarly, the interest rate policy, which emphasizes on lowering BIR or aggregate interest rate to 5 percent real interest rate, is addressed by monetary policy.

The analysis of the stated hypothesis in the study suggests that lack of financing access and higher interest rates cause slow agriculture sector growth rate. Based on the positive results of the policy propositions as discussed in section 4.1, the government of Nepal and the central bank of Nepal need to consider the policies. The results of the policy tests clearly exhibit the causalities of formal banking share and interest rate in the Nepalese agriculture sector. As a higher share of formal banking access and lower interest rate cause the agriculture sector to grow and vice versa, as justified by the policy tests, this facilitates a clearer understanding of the importance of rural banking and subsidized interest rate for the agriculture sector growth.

4.3.1. Required Actions for a Successful Implementation of the Policy Propositions

The success of every policy strictly relies on how the policy is implemented. To implement every policy, an implementation guideline is vital. Hence, the study proposes the following action plans for a successful implementation of the policy propositions.

- The government of Nepal should set a target to increase the formal banking sector access for the agriculture sector to 40 percent from the next issue of fiscal policy
- The policy should not only state the target but also strictly highlight the procedure of achieving this target

- All the regulated financial institutions in the Nepalese banking sector should be guided to increase their access to rural agro sector and increase their portfolios in the agriculture sector to at least 15 percent of their respective total portfolio
- The government of Nepal should focus on increasing access of banking in the agriculture eco-system, including storage and transportation
- The Ministry of Agriculture should focus on facilitating educational campaigns in the agriculture sector, assure better product markets and eliminate involvement of market intermediaries
- The next monetary policy, Monetary Policy 2072/73 (2015/16), and policies thereafter, should strictly prohibit banks and financial institutions to charge interest rates higher than 5 percent real interest rate in the agriculture sector, gradually reducing the rates in the following years

4.4. Policy Propositions and Implementation Issues Discussed

The policies proposed in the study are considered taking into account the causalities of formal banking market share and interest rates on production. In the model, interest rate and market share of formal banking are independent variables, whereas, production and contribution of the agriculture sector to GDP are dependent variables. Besides, the hypothesis in the study states that lack of effective and efficient financing mechanisms combined with higher interest rates cause slow agriculture growth rate. Since the hypothesis is verified or stated to be true in the analysis section of the study, the policies are proposed to best fit the agriculture sector in Nepal. Furthermore, the tested policies generate impressive results; successful implementation of these policies, which also depends on following implementation actions (section 4.3.1), would significantly increase productivity in the Nepalese agriculture sector.

5. Conclusions

Nepal, an economy based on agriculture, has been realizing a slow agriculture sector growth for over a decade. With the agriculture sector not gaining momentum, the overall economy of Nepal faces several negative economic consequences. The study states a hypothesis that lack of effective and efficient financing mechanism, including higher interest rates, cause slow agriculture sector growth. The analysis of the hypothesis strongly supports and validates the hypothesis. The study reveals that Nepal lacks sufficient banking access to the rural agriculture sector. This causes aggregate interest rates to rise, as informal sector exploit farmers by charging higher interest rates, resulting in reduced investment and production in the sector. Thus, the analysis of the study concludes that higher the banking access, lower the interest rate and higher the productivity and vice versa.

The conducted study is believed to be first of its kind in the Nepalese agriculture sector where banking access and interest rates are directly associated to the outcome of the agriculture sector. The study gives interesting new insights in the Nepalese agriculture sector. Increase in banking access to the rural agriculture sector pulls down interest rates in the formal banking sector, as a result of increased competition, which gradually adjusts interest rates in the informal sector. This causes aggregate interest rate to fall. As aggregate interest rate falls, the volume of capital in the agriculture sector increases, meeting the desired investment, which contributes to production. This increases income, saving and investment, generating a multiplier effect in the economy. Furthermore, the study also exhibits that increase in the volume of mobilized capital in the economy puts a downward pressure on interest rates, causing rates to gradually decline over time. Thus, with an increasing level of production, backed by lower interest rates, cost per unit of output also gradually decreases over time with increase in production efficiency.

Considering the slow agriculture growth rate in the Nepalese agriculture sector and the positive outcome of the policy propositions as tested in Chapter 4, the government of Nepal is recommended to adopt a public-private partnership model for banking expansion. The recommended model for banking expansion would collaborate efforts of the government of Nepal and banking sector in enhancing formal sector banking access to the rural agriculture sector. Furthermore, as lowering bank rate has a tremendous positive impact on productivity, an immediate rate cut (lowering bank rate) is also recommended.

Finally, since the study is precisely focused on causalities of interest rates and formal banking share on the Nepalese agriculture sector, a further research comprising qualitative effects of interest rates and banking access is suggested. Variables like knowledge sharing via increased banking access, effect of technology transfers and involvement of market intermediaries could be further considered in future researches.

References

Ajit, D. and R. D. Bangar (1998) The Role and Performance of Private Sector Banks in India, Political Economy Journal of India, Vol. 1, 1-4.

Arora, D. (2010) Banking Risk Management in India and RBI Supervision: Class of PGDM. India: BIMTECH.

BIS (2010): Implications for Banking Supervision: BIS Papers No. 1, Basel.

Berger, A. N. and R. DeYoung (1997) Problem Loans and Cost efficiency in Commercial Banks, Journal of Banking and Finance, Vol. 21, 849-870.

Bhayana, S. (2010) Corporate Governance Practices in India. India: Deep and Deep Publications.

Coyle, G. (1998) The Practice of System Dynamics: Milestones, Lessons and Ideas from 30 years' Experience, System Dynamics Society Lifetime Achievement Award.

Fuglie, K.O. (2008) Is a Slowdown in Agricultural Productivity Growth Contributing to the Rise in Commodity Prices?, Economic Research Service, U.S Department of Agriculture, 1800 M Street, NW, Washington, DC 20036, USA.

Government of Nepal (2014) Economic Survey, Fiscal Year 2013/14, Ministry of Finance, Singha Durbar, Kathmandu, Nepal.

Government of Nepal (2013) National Report, National Sample Census of Agriculture Nepal 2011/12, National Planning Commission Secretariat, Central Bureau of Statistics, Kathmandu, Nepal.

Government of Nepal (2013) Summary of Agriculture Census, Ministry of Agriculture, Kathmandu, Nepal.

Hatlebakk, M. (2009) Capacity-constrained Collusive Price Discrimination in the Informal Rural Credit Markets of Nepal, Review of Development Economics, 13(1), 70-86.

Irz, X., L. Lin, C. Thirtle, and S. Wiggins (2001) Agricultural Productivity Growth and Poverty Alleviation, Development Policy Review, 19(4), 449-466.

Joshi, K.D., C. Conroy, and J.R. Witcombe (2012) Agriculture, Seed, and Innovation in Nepal: Industry and Policy Issues for the Future, International Food Policy Research Institute.

Mahat, R.S. (2014) Budget of Fiscal Year 2014/15, Government of Nepal, Ministry of Finance, Kathmandu, Nepal.

Nepal Rastra Bank (2014) List of Banks and Financial Institutions, Kathmandu, Nepal.

Nepal Rastra Bank (2014) Monetary Policy for Fiscal Year 2014/15, Central Bank of Nepal, Central Office, Baluwatar, Kathmandu, Nepal.

Nepal Rastra Bank (2014) Current Macro Economic Situation of Nepal, Central Office, Kathmandu, Nepal.

Pant, P.R. (2010). Business Environment in Nepal. Kathmandu, Nepal: Buddha Academic Publishers and Distributors Pvt. Ltd.

Shrestha, R.B., W. Huang, and R. Ghimire (2010) Market Price Co-integration of Tomato: Effects to Nepalese Farmers, International Journal of Food and Agriculture Economics, 2(2), 87-96.

Sterman, J.D. (2000) Business Dynamics: System Thinking and Modeling for a Complex World. United States of America: The McGraw-Hill Companies, Inc.

Thapa, R.B. and D.B. Rawal (2010) Principles and Practices of Nepalese Banking. Kathmandu: Buddha Academic Publishers and Distributors Pvt. Ltd.

Tiffin, R. and X. Irz (2005) Is Agriculture the Engine of Growth?, Department of Agricultural and Food Economics, University of Reading, Reading, RG6 6A5, UK.

Appendices

<u>Equations used for the study in the 'i-think' Model (Financing and Agriculture)</u>

Capital_Mobilized(t) = Capital_Mobilized(t - dt) + (Investment - Depreciation) * dt

INIT Capital_Mobilized = 200000000000

INFLOWS:

Investment = (Actual_Borrowing_Rate+Retained_Earnings)

OUTFLOWS:

Depreciation = Capital_Mobilized*Depreciation_Factor

Formal_Banking_Market_Share(t) = Formal_Banking_Market_Share(t - dt) + (Change_in_Market_Share) * dt

INIT Formal_Banking_Market_Share = 0.02

INFLOWS:

Change_in_Market_Share = (Desired_Market_Share-Formal_Banking_Market_Share)/Fiscal_Implementation_on_Expansion

Informal_Sector_Interest_Rate(t) = Informal_Sector_Interest_Rate(t - dt) + (Interest_Rate_Adjustment) * dt

INIT Informal_Sector_Interest_Rate = 0.22

INFLOWS:

Interest_Rate_Adjustment = (Aggregate_Interest_Rate-Informal_Sector_Interest_Rate)/Adjustment_Period

Total_Debt(t) = Total_Debt(t - dt) + (Actual_Borrowing_Rate - Debt_Repayment_Rate) * dt

INIT Total_Debt = 180000000000

INFLOWS:

Actual_Borrowing_Rate = Min(Desired_Borrowing,Maximum_Allowable_Loan)

OUTFLOWS:

Debt_Repayment_Rate = Total_Debt/Average_Time

Actual_Interest_Rate = bank_interest_rate/(if(Collateral_Adequacy<.5)then(.5)else(min(Collateral_Adequacy,5)))

Adjustment_Interval = 1.05

Adjustment_Period = 10

Aggregate_Interest_Rate = max(.02,(Actual_Interest_Rate*Limited_Formal_Sector_Market_Share+Informal_Sector_Interest_Rate*Informal_Sector_Market_Share)/(Limited_Formal_Sector_Market_Share+Informal_Sector_Market_Share))

Average_Time = 10

Bank_Interest_Rate = if(time>2014)and(Interest_Rate_Policy_Switch>0)then(Policy_for_Bank_Interest_Rate)else(0.08)

Base_Year_Capital = 200000000000

Base_Year_Demand = 1750000000

Base_Year_Price = 100

Base_Year_Production = 1500000000

Basic_Demand = Base_Year_Demand*Households/Households_in_Base_Year

Billion = 1000000000

Capital_Exponent = 0.55

Collateral_Adequacy = (Capital_Mobilized/Total_Debt)

Contribution_of_the_Agriculture_Sector_to_GDP = Production*Base_Year_Price

Data = GRAPH(TIME)

(2000, 150), (2001, 155), (2002, 160), (2003, 165), (2004, 174), (2005, 180), (2006, 183), (2007, 185), (2008, 195), (2009, 202), (2010, 205), (2011, 215), (2012, 225), (2013, 227), (2014, 238)

Depreciation_Factor = 0.1

Desired_Borrowing = Desired_Investment-Retained_Earnings

Desired_Capital = ((Capital_Exponent*Production*Price)/(Aggregate_Interest_Rate+Depreciation_Factor))

Desired_Investment = (Desired_Capital-Capital_Mobilized)/Adjustment_Interval

Desired_Market_Share = (Desired_Capital-Capital_Mobilized)/Income

Fiscal_Implementation_on_Expansion = (net_income/Capital_Mobilized)/Fiscal_Policy_Focus

Fiscal_Policy_Focus = 0.005

Formal_Banking_Market_Share_Policy = if(time>2014)and(Formal_Banking_Policy_Switch>0)then(Policy_for_Formal_Banking_Market_Share)else(Formal_Banking_Market_Share)

Households = Households_in_Base_Year*EXP(0.0140*(time-2000))

Households_in_Base_Year = 3400000

Household_Exponent = 0.45

Income = Production*Price

Informal_Sector_Market_Share = 0.17

Interest_Repayment = Total_Debt*Aggregate_Interest_Rate

Limited_Formal_Sector_Market_Share = min(Formal_Banking_Market_Share_Policy,(1-Informal_Sector_Market_Share))

Maximum_Allowable_Loan = (Retained_Earnings/Aggregate_Interest_Rate)

Net_Income = income-Interest_Repayment-Debt_Repayment_Rate

Price = (Base_Year_Price*(Production/Basic_Demand)^(-1/Price_Elasticity))

Price_Elasticity = 0.95

Production = Base_Year_Production*((Households/Households_in_Base_Year)^Household_Exponent)*((Capital_Mobilized/Base_Year_Capital)^Capital_Exponent)

Production_Data = Data*10000000

Propensity_to_Save = 0.05

Retained_Earnings = net_income*Propensity_to_Save

Simulation = Contribution_of_the_Agriculture_Sector_to_GDP/Billion

Equations given for policy propositions in the model

Interest_Rate_Policy_Switch = 0/1

Policy_for_Bank_Interest_Rate = 0.05

Formal_Banking_Policy_Switch = 0/1

Policy_for_Formal_Banking_Market_Share = 0.4

Nepali calendar and Gregorian calendar Conversion

2014/15 AD approximately corresponds 2071/72 BS

<u>The model, 'Financing and Agriculture.itmx', developed for the study using 'i-think'</u>